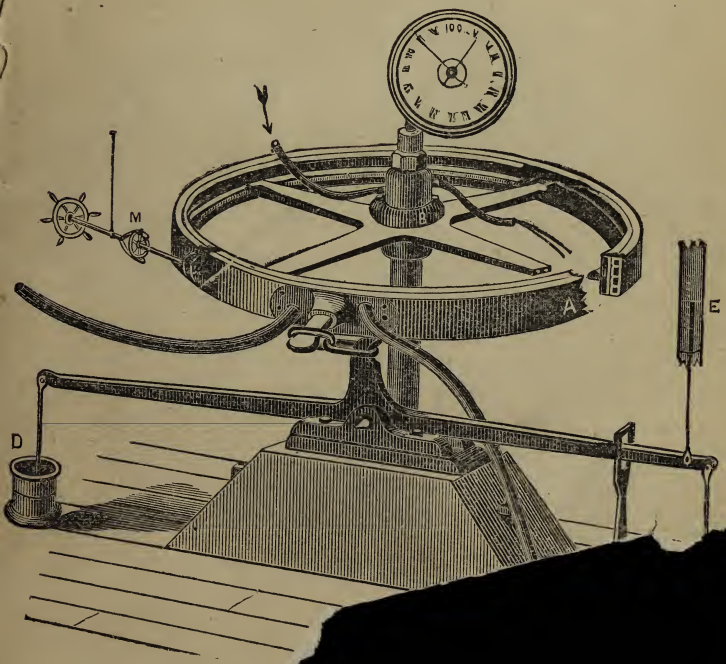
Fourth Annual Report

—OF—

Turbine Tests,



BY

Introduction to Second Edition.

THE applications for my Report of Turbine Tests for 1872 have been so numerous that a second edition is required and the opportunity is improved to mention a subject forgotten when the first edition was written, namely, the idea suggested in my Report for 1871, that seemingly low heads produce the highest percentage. The experiments since prove the contrary to be the fact. With wheels properly constructed the percentage invariably increases as the head is increased, to an extent beyond my experience.

The Mount Holly Wheel was sent to and tested in Holyoke flume under about six feet head, giving a useful effect of 79.4 per cent. instead of the 84.6 reported as obtained at Mount Holly. The wheel was in some respects like the Van de Water of Rochester, N. Y., but it was tested in the Warren curb.

The wheel from which Mr. Risdon obtained 85.91 per cent. was of greater capacity for its size and differed materially from the first and was tested in curb patented by J. T. Case of Bristol, Ct.

Mr. Risdon has been unable to purchase the right to use the said curb, but he is skillful and energetic and doubtless will soon produce a curb equal, if not superior, to the one abandoned; but until he does so, to continue to advertise 86 per cent. wheels, to me seems both unjust and injudicious, for there are plenty of those who use wheels ready to take advantage of the prevailing misrepresentations, and it is quite common for such to misrepresent the merits of wheels they have in use, for the purpose of deferring payment or to obtain a discount in price through the builders' fears of injury to the wheel's reputation by displacement. Recently two such parties have written to me bitterly complaining of their wheels and threatening to "pitch them out, and I guess ——— will never sell any more wheels in this vicinity." I had had nothing to do with those particular wheels, but knew the builders to be reliable, and at once offered to test the wheels at their mills and look to the builder for my pay if the wheels were not fully up to the guarantee. My offer was received in anything but a friendly spirit.

The aspirations of such purchasers and the advertisements and circulars published by many of the builders, daily prove the imperative necessity for a law to regulate the sale of Motors. On page 11 of

this Report may be found a notice of the Swain Turbine. Since the publication of that notice, a pamphlet issued by the Swain Co. has been sent to me that for richness of imagination has seldom been excelled by the wildest of the Wild Cat fraternity. The Swain Wheel if thoroughly made and well set is a good one, it gives good power for its size and the 42-inch gave good percentage. The other sizes tested have not proved so good. Its highest whole gate results have been greatly excelled by the Houston, Risdon and Hunt Wheels and equalled by several others. Its part gate results have been equalled by several wheels and entirely outdone by the "American" or "Dayton." From its complicated construction there is probably no wheel in the market so likely to require repairs nor one so likely to give trouble through its tendency to clog with sticks, shavings, leaves, eels, etc., a wire screen being required for small wheels and a very fine rack for the largest.

Many of those referred to in the pamphlet, if applied to for information, would probably be less enthusiastic than the publication of their names would seem to indicate. I certainly heard Mr. Boyden, Superintendent of the Prescott Mills, tell Mr. Swain that he did not believe the wheels in the Prescott Mills were giving over 70 per cent. I have recently seen a letter from W. H. Rogers, of Los Gatos, Cal., in which the Swain Wheel and Co. is anything but commended. The Swain Co. has changed very much since 1869. Mr. Swain was then Manager. He has since been superseded and the Company is now managed by H. W. Boardman, better known to manufacturers as the manager of the "Abel Knitting Machine," that was agoing to supersede the entire use of looms in the woolen manufacture. "State rights," valued at millions, pay taken in almost anything from a coon skin to a "trotting park." If one may judge from style, Mr. Boardman feels cramped within the narrow range of the "seven shops" !!!! engaged in the manufacture of Swain Turbine, so has started a "Lowell Water Wheel Co.," from which has recently emanated circulars purporting to represent wheels furnished by that Company almost as remarkable in effect as the "Abel Knitting Loom." There is certainly an opening for manufacturers desirous of experimenting.

The following letter was received after the foregoing was in type:

JAMES EMERSON, HOLYOKE, MASS.—DEAR SIR: In your letter of April 23d, last, you refer to a pamphlet just issued by the Swain Turbine Co., with additions and interpolations to the matter as prepared by the writer for the edition of 1871. Believing as I do, that the Swain Wheel possesses several very important advantages over any other Turbine Wheel yet constructed, and that

it is capable of being wrought up to the very highest efficiency, or may be of the very cheapest construction if need be. Therefore I the more regret to see the marginal additions as published in said pamphlet, deeming them worse than useless. They could never have gone in there with my approval. I trust you will have the kindness to discriminate between Swain Turbine Co., and myself, and bear me witness that I have no sympathy with that style of advertising.

Very truly yours, A. M. SWAIN.

NORTH CHELMSFORD, MASS., May 9, 1873.

There is no reason to doubt that the Swain Wheel *could* be worked up to the highest standard, but Mr. Boardman's previous pecuniary success seems to have impressed the company with the idea that a skilled engineer like Mr. Swain was rather an encumbrance than otherwise, consequently the management was transferred to Mr. Boardman, who, however, it is but fair to say, is ably assisted by Mr. Nichols, one of the old company, whose qualifications will best be understood by the relation of a little anecdote.

Previous to the public experiments in 1869, there was a private test of a 30-inch Swain Wheel, at Graniteville. One of my Lever Dynamometers was used; the levers were heavy, causing several hundred pounds to be added to the real weight. The centrifugal force should have been found and deducted as scales are balanced before weighing, but the matter was not then understood, and the whole was added, showing a useful effect apparently of about 170 per cent. "Ah, won't they stick out their eyes when they see that!" says Mr. Nichols, and it was rather hard work to convince him the less said about *that* the better. Perceptibly he continues to hold his own. Mr. Swain's letter allows me to offer a few personal remarks. It has been intimated that personal feelings influence my reports. Only the unthinking or dishonest will harbor such an idea. The builder that obtains 80 per cent. invariably tries again and again, the one who gets 40 or 50 per cent. is pretty sure to end with the first trial. As a general thing experimenters are poor men, no man of feelings would willingly inform such that their hopes are blasted. The parties that have been credited with influencing me have actually paid me less than some that have been sent to the "Old Junk Shop." J. W. Upham, of Worcester, I think has paid me more than any other party, and his reports will speak for themselves. I do not like "private tests;" the highest results are invariably obtained through experimenting, no man can theoretically determine the best form, and while experimenting the results often go down instead of up, the honest man is indifferent who knows it.

If a man abandons his wheel I may pass his test as experimental, but if he ignores the test, and retires to the columns of some self-styled scientific paper, and advertises his wheel as the "best in the world," he will find his results in full in my next Report. The following letter is published to show that it is not necessary to take that course to be known:

BUFFALO, N. Y., March 19, 1873.

JAMES EMERSON, ESQ., HOLYOKE, MASS.—DEAR SIR: We are in receipt of your last annual report, "Turbine Tests," for which we are much obliged. The large number of "very high" Turbines in the market hawked all over the West by special agents, has reduced our sales of wheels very much the past two or three years. Our wheels have generally given good satisfaction. Steady driver and medium in percentage. It has become absolutely necessary to have your tests to compete with others, we have concluded to send you one of our 30-inch wheels to test, that we may learn how we stand.

Our tables are correct or nearly so on velocity—and probably on discharge. The power given is what we have had no means to test.

Respectfully, JOHN T. NOYE & SON.

Every intelligent manufacturer must know that the last five years have created a revolution in the wheel business. In 1869 a 73 per cent. wheel was considered rather extra, while now anything less than the eighties would obtain little consideration. This change has injured many and perhaps ruined several wheel builders; at the same time it has been anything but a lucrative business to bring about such a change. My Reports may be less dignified than the general ponderous style, but they are my style, and the experiments are always made with the understanding that the builder has the right to the assistance of a competent engineer to witness the proceedings, and whenever an error of one-fourth of one per cent. can be discovered the test to be gratuitous. I do not like a dishonest man, whether wheel builder or manufacturer, but am not aware of any personal ill-feelings toward any one. Mr. Swain is intelligent and a thorough mechanic, and one of my most esteemed friends.

Mr. Boardman is a pleasant acquaintance, but we differ as to the value of wind in operating Turbines.

Jeff., well, really, what can I say of Jeff. Chase, more than that he is a jolly good fellow with astounding Munchausen proclivities that are very *taking*, as many a backwoodsman will yet learn unless a law is soon passed to regulate the sale of Motors.

JAMES EMERSON.

MAY 15, 1873.

☞ Attention is called to test of Hunt Wheel on page 42.

REPORT.

THE act of writing a Report of this kind naturally causes a retrospection of the earlier stages of the business, and as the mind returns to a period of only five years since, it brings to view a lack of intelligence, relative to motors in no way creditable to professional engineers, to the spirit of the age or profitable to the manufacturing interest of the country. Turbine Wheel builders by the hundreds, each claiming to be *the* builder *par excellence*, each claiming absolute impossibilities.

Five years of hard, persistent labor have done much to bring order out of the confusion, for many of the loudest mouthed, have been silenced and their wheels consigned to the "Old Junk Shop" while others have modestly retired to places unvisited by the locomotive or telegraph and there in company with the "Hair Oil man" continue their sales through the most persistent lying. During this period every wheel of any general reputation has been subjected to thorough and decisive trial and its merit determined. Of course there are hundreds of builders belonging to the Wild Cat fraternity who have had no such trials nor ever will have, yet who puff their traps with the same assurance and reliability as another branch of the same brotherhood located at 57 Liberty street, N. Y., offered *improved* thousand dollar greenbacks for ten dollars' worth of the common kind. The Turbine is far from being perfected and doubtless many names now unknown will yet become prominent in the business, but the time has indeed passed for running Turbine Water Wheels by wind, for under the present knowledge of the impossibility of guessing the merits of a wheel and the utter worthlessness of statements made by interested parties, no honorable builder will sell wheels without first ascertaining their value as motors. The past season has developed much of importance to builders and users of Turbines; lengthening the chutes has increased the useful effect of several wheels, and there are no good reasons, seemingly, why it should not do so to others. Causing wheels to give their best percentage at about

three-fourths gate, under certain circumstances, is another important step towards economizing water. But after all I believe the agreement of the best builders to sell wheels by test, is the most decided step in advance, and if generally encouraged by the users of wheels, as it seems likely to be will soon render the purchase of a reliable water wheel as certain as any other article, and end dishonest competition, allowing honorable builders to furnish a better wheel at the same price.

The coming season is likely to produce wheels of high useful effect. The Messrs. Risdon and Houston are equally skillful and both determined to go higher and stand at the head, while Burnham and Case have no inclination nor intention of standing second; Whitney, I am glad to say, has now taken a high stand and is determined to rise.

The peculiarity of the Dayton Wheel is its high average economy, still its builders have no intention of resting on that merit, and it is a rather interesting point as to who will stand as "*High*" next January. It is not at all certain that some name now unknown may not put in a claim for that position. Larger wheels will be tried the present season most likely, as the highest results have been obtained by the largest wheel tested. Three years' experience at Lowell testing small wheels, convinced me of the necessity of extending the experiments to large wheels. A sufficient supply of water, however, could not be obtained there, necessitating change of location. S. S. Chase, agent of the Water Power Co., here generously offered the gratuitous use of water and a granite lock for the purpose, probably the very best place that could be found; the offer was accepted and a new Flume constructed, and here I wish to return my most sincere thanks to Mr. Chase for his many acts of kindness, also to Mr. Whiting, agent Whiting Paper Co., for his ready assistance in emergencies that I could hardly have overcome without the aid he so kindly rendered.

JAMES EMERSON.

Holyoke, Mass., February 21, 1873.

NOTICE

—TO—

Wheel Builders and Manufacturers.

It is now well known to the builders and users of Water Wheels throughout the country that the most noted wheels have been subjected to thorough and decisive trials at the Lowell and Holyoke Testing Flumes, which has rendered the selection of an economical wheel a matter of far greater certainty than before such trials commenced, but the almost daily debut of new builders and the constant changes made by the old, necessitates the test of every wheel to ensure absolute safety to the purchaser or builder, for a large proportion of the wheels sent to be tested require re-building, or at least considerable finishing up, before being in a condition to run. There is no reason to suppose more pains are taken with those sent to purchasers. When in condition to be tested, the wheel is in condition to be used wherever its merit warrants its use, and as the test decides its absolute merit, if it does not answer the purchaser's expectation, it is plain that the wheel is either improperly set, or that more is required of it than is reasonable to expect.*

Within the past four years I presume that I have had to do with the sale of more wheels than any other person in the country, and so far as I have heard, with hardly an exception, wheels that I have recommended have given excellent satisfaction. Many of the builders for whom I have tested, have of-

*Is it not singular where so much is depending, that those about to purchase motors do not first ascertain, by actual trial, the amount of power required, instead of guessing at it, then running at a loss of power afterwards the most of the time; and still more singular that our legislators have been so careful to guard the interests of all classes except the one to which the state is most indebted for its prosperity. The babe must not be cheated in the measurement of its milk; the boy must have his exact half-pint of peanuts; the man his ton of coal or cord of wood, while the manufacturer has no protection, so far as the law is concerned, against the misrepresentations of merit so generally circulated by those interested in the sale of motors. The exact quantity of milk, peanuts, or coal, may be easily verified by anyone, and if not correct the loss can be but a trifle, but a poor motor may cause the loss of thousands of dollars.

fered me commission as an inducement to sell their wheels, but up to this time I have never received a dime in that way, all statements to the contrary notwithstanding.

Hereafter I will act as agent for any wheel that has been tested. Every wheel that I sell I will test, (under 18 feet head, or the head at which it is to be used, if less than 18 feet, giving a certificate of its merit as a motor, speed to be geared, &c.,) charging ten per cent. to the seller of the wheel, (list price,) for so doing. Wheel to be sent to and taken from my Flume by the parties interested. The names of such builders as desire me to act for them are published with report, that purchasers may deal with those willing to sell wheels at their true standard of usefulness.

O. E. MERRILL & CO., Beloit, Wis., . . . "Houston Wheel."
FALES, JENKS & SONS, Pawtucket, R. I., . "Houston Wheel."
N. F. BURNHAM, York, Pa., ... "Burnham's New Turbine."
T. H. RISDON & Co., Mount Holly, N. J., . . "Risdon Wheel."
STOUT, MILLS & TEMPLE, Dayton, O., . . "Dayton Wheel."
HOLYOKE MACHINE CO., Holyoke, Mass., . "Dayton Wheel."
BARBER & BAKER, Ballston Spa., N. Y., . . "Barber Wheel."
URBANA MACHINE WORKS, Urbana, O., . "Small's Turbine."
RODNEY HUNT MACHINE CO., Orange, Mass., "Hunt, Wait & Flint Wheel."
J. W. PHAM, Worcester, Mass., . . "Upham & Libby Wheel."
A. P. HOLCOMB, Silver Creek, N. Y., . . "Thompson Wheel."
W. J. THOMPSON, Springfield, Mo., . . "Thompson Wheel."
NATIONAL WATER WHEEL CO., Bristol, Ct., "Case Wheel."
WALDO WHITNEY, Leominster, Mass., . "Whitney Wheel."

Will sell wheels upon the above terms, delivering wheels at Holyoke, purchasers to take them from my Flume. These names embrace the very best builders now known. By purchasing as above, the purchaser will enable the honorable builder to furnish a better wheel for the same price, as such a course will discourage dishonest competition, it will also do away with the idea that better wheels are furnished to be tested than to the trade.

JAMES EMERSON,
Box 75, Holyoke, Mass.

JANUARY 1, 1873.

To Correspondents and Others.

Every mail brings applications for "Report of Turbine Tests." Some enclose stamps, some a dollar, others more, many less; while others say, "send bill, which will be remitted by mail." Such letters have been kept, but will be destroyed with the distribution of the Report for 1872. "My Reports are for gratuitous distribution," but hereafter will only be sent to those directly interested, and to those who send stamped envelopes, fully addressed for return of Report. If any one thinks this a small matter, let him sit down and decipher the addresses of a thousand correspondents, and if he arises in a happy frame of mind he should be ranked with Mark Tapley at once.

"Draft Tubes" properly constructed and applied, may be used without loss of useful effect.

"Brass buckets" are the tubs thrown to, and swallowed by fat whales like the Lowell corporations, but their *costive* effect retards the growth, if we may judge by comparative rate of progress between Lowell and Fall River.

Wheels of any make will occasionally wear down step. I know of no exception. Some perhaps are worse than others, but so far as my knowledge extends, I should be at a loss to decide which to reject on that account.

All gates bother more or less. The "Register" works have at times. The "Fly Trap," (so called, I presume, from a fancied resemblance between the Leffel gates and that useful implement,) leaks badly. The "Cylinder Gate" injuriously affects the part-gate results.

The Swain gate breaks at times, so that the wheel cannot be stopped until the water is drawn off, or the gate repaired. I have known the wheel to run continuously two or three days because the gate could not be closed.

Of the Dayton Wheel gate I know nothing, only of the one used on wheel tested, that worked well. So do any of them generally when new.

The term "Wild-cat" wheel builder, arises probably from analogy to the "Wild-cat currency" issued by irresponsible parties, and so called in derision, a generation since.

I have seen the advertisement but it has no foundation, no 84 per cent. was ever obtained in the Lowell Flume, nor have I ever tested a Van De Water Wheel. The advertiser is probably trying to sell wheels on some other wheel's reputation; but I have often published reports showing plainly that a resemblance is no guarantee of merit. George A. Houston gets nearly 87 per cent from a wheel resembling a Mitre gear in form. J. T. Case tries the same form and gets 47. It is the man that makes the wheel, not the patent.

That the poorest wheel builders circulate the most astonishing certificates, is a fact that can only be accounted for by the supposition that such are forgeries, or are given by persons ignorant of what a good wheel should do. Responsible parties are never in haste to give such, nor do honorable builders desire them. A certificate of merit, obtained by actual competitive trial in a Testing Flume, is far better, though the dishonorable builder may *pretend* to doubt.

Not long since, a wheel was brought to me to be tested. It had a thorough trial, but the results obtained and those claimed differed extremely. The wheel was boxed, entirely concealing it from view; my cards, with printed headings, were rejected, the builder walking a mile to procure plain ones on which to write directions for transportation. I have just received a highly-colored circular issued by the builders of that wheel. It is filled with the most astounding certificates relative to the merits of the wheel, but for some reason the builders have forgotten to publish the one obtained from Lowell experiments.

Yes, I believe Mr. Francis' formula to be very accurate, and know it to be perfectly constant, so much so that the same wheel may be put into the flume, tested, taken out and the process repeated every month in the year, and if the wheel is kept in order, the results will not vary one pound in five hundred, consequently of the relative merits of wheels tested in the same flume there can be no question, nor can any such accuracy be attained by raising weights as was done at the Philadelphia tests.

Nearly the whole edition of the work published by me last spring, "Tests of Water Wheels and Machinery," was sold

before it was out of the bindery. None to be had now unless Henry C. Baird of Philadelphia has a few copies. I shall probably publish another edition soon, and I would here ask every wheel builder in the country to send me electrotypes representing the wheel now built by them, or any one that has been built by them and abandoned, and I will publish them in the same style as those in the first edition ; a section representing wheel is necessary. The cuts must be limited in size, so they can be printed in a book the size of this report. The object of publishing diagrams of abandoned plans, is to prevent the re-appearance of wheels known to be worthless—certainly a large proportion of the *new wheels* are very old and very worthless. I would also ask every wheel builder to send me two copies of circulars representing any wheel of any period, of their make, and if any one in Michigan or other part of the country, can furnish me a circular issued by Mr. Wynkoop, in which the wise men of Owosso, (mayor, city marshal, principal of high school, and twenty others,) say they have seen it (the Wynkoop Wheel) work, and believe it returns a useful effect of from 175 to 200 per cent, etc., they will confer a great favor.

As from 25 to 33 per cent. of the whole power is required to drive the shafting in a mill, less than half-gate results are of little practical utility.

Breast Wheels.

Many persons write, "Is there any Turbine Wheel equal in useful effect to the Breast or Over-shot wheel?" My experience has been very limited with such but in each case where I have recommended Turbines to take the place of such wheels the result has been an increase of power besides many other advantages, such as higher speed requiring less gearing, steadier motion, freedom from trouble by freezing, back water, etc.

The Fourneyron Wheel.

A French invention, used only to a very limited extent in this country and almost entirely by corporations like those at Lowell. There are vague rumors of fabulous percentage having been obtained by a Mr. Boyden, but I am unable to

trace such to any authentic source. It is true Mr. Francis says in his work called "Hydraulic Experiments" "The observations were placed in my hands for computation which showed a useful effect of 88 per cent," and he might have added that other builders have since furnished "Observations" for computation that showed a hundred per cent. and upwards, such are not at all uncommon. Two years since during very low water one of the Lowell agents, informed me that while running his work as usual the day before with four wheels he was charged with 15 per cent. excess for use of water; that before starting that morning he had detached one wheel and was running the same work with three and was credited with 15 per cent., thus showing a difference of thirty per cent., and from the nature of the gate the wheel must be one of the very poorest in the country at part gate, while at whole gate it must be inferior to a half dozen now in common use either of which if constructed in the same thorough manner the Fourneyron is, would do more work at one-fourth the first cost per wheel while it would take less pit room, run at higher speed besides many other advantages, in fact but little is really known of the real comparative merit of the wheel for it has never been tested except by its builder, at least no other person has ever published any remarkable results obtained. The excuse at Lowell has been "Oh, it would cost so much to build an instrument to test one," but that excuse is good no longer, the instruments are ready at any time you want them Messrs. agents, and the cost need not be large. One manufacturer remarked to me not long since "I have not paid $5 for repairs of wheels in twenty years;" well the same remark has often been made to me about the Tyler Wheel but if either party had to pay by measurement for water used by a twenty years' wheel, it would be found more profitable to pay something for repairs occasionally especially if interest on cost of Fourneyron was taken into consideration. It is not long since I had an opportunity to try the merit of two twenty-year Fourneyron Wheels, their useful effect was about 44 per cent. Several parties have recently constructed wheels resembling the Houston and the useful effect has varied from 47 to 86.75 per cent. As the Fourneyron is manufactured by different parties and entirely upon theoretic principles who can vouch for its efficiency?

Swain Wheel.

Manufactured by the Swain Turbine Co., Lowell, Mass.

As pioneers in the first really practical movement likely to protect the manufacturing interest of the country by compelling the production and sale of economical motors, more credit is due Mr. Swain and his Company than to any other wheel builders or engineers, but unfortunately for the Company the expense of testing a Turbine at that time was a serious item, and many thousand dollars were expended in a limited number of experiments with wheels previously constructed, and though changes have since been made, the Company, like Don Quixote after repairing his helmet, say, "Of course they are perfect now, so there is no use of trying them." Several wheels, varying in size from 24 to 42 inches in diameter were tested, the results may be seen below:

	Head in Feet.	Perc't-age, ½ gate.	Perc't-age, ¾ gate.	Perc't-age, ⅞ gate.	Perc't-age, Whole gate.	Horse Power, Whole gate.
42-inch	14.25				82.2	63.00
36-inch	15.10					
36-inch	15.10	43.20	67.00	71.90	74.69	45.40
30-inch	15.41	47.30	59.20	72.80	76.17	36.40
24-inch	16.66	54.17	72.30		77.69	24.26
24-inch	15.89	55.40	67.60	72.90	72.60	18.07

The wheel has thin sheet iron buckets, very close together, is complicated and expensive and really should be built in the same manner as the Fourneyron is instead of being cast in a lump. The guides sometimes get loose and go into the wheel when running. The step burns out in many cases giving much trouble in that way and the gate is apt to get out of order; it requires a very fine rack and for small wheels a wire screen, and then requires much care; its advantages are, great power for its size, and when properly constructed, good percentage at either whole or part gate, it probably might be materially improved by leaving out at least one-third of its buckets, certainly it would be far less likely to become clogged by leaves, sticks, shavings, eels, etc.

Bodine Jonval, Register Gate.

A very steady running wheel giving about 76 per cent. useful effect when well made, but so far as I know, is not manufactured now.

Bryson Turret, "Fly-trap" Gate.

Was manufactured by Miles Greenwood of Cincinnati, Ohio, but I have been informed that the patent belongs to James Raney of New Castle, Pa., and is now manufactured by him. The wheel sent by Mr. Greenwood to be tested gave about 75 per cent., 75.14, run remarkably steady and was considered capable of considerable improvement but Mr. Raney sent one of the same kind with more buckets (16) that did not do so well, but it was very roughly constructed, bound in the curb, and of inferior workmanship.

Tice Wheel, Cincinnati, Ohio.

Sent to the Old Junk Shop.

Trullinger, Oswego, Oregon.

Sent after Tice's wheel.

Kindleberger, Cincinnati, Ohio.

Sent after Trullinger's wheel.

Stetson's Wheel, Register Gate.

Manufactured at Fitchburg, Mass.

This wheel is made upon the same general principle as the Whitney, Burnham, Wheeler, Risdon, and many others, as may be seen in Report for 1871. Mr. Stetson has had several wheels tested varying in useful effect from 74.10 to 79.26; his wheel is rather limited in power for its size but it gives very good part gate results but for some reason with which I am unacquainted he charges more than other builders who construct wheels of equal or superior merit.

Upham Scroll, Worcester, Mass.

A good scroll but I think not manufactured now.

Luther Scroll, Iowa.

The most substantial scroll wheel I have ever seen and the steadiest and easiest to control of any wheel I have ever attempted to handle with dynamometer, but of very small power for its size while it is quite expensive. Useful effect of a 30-inch wheel, 70.4 per cent.

Wheeler of Berlin, Mass.

This wheel has recently changed its location but I am unable to give its present one. Register gate and is similar to Stetson's, Burnham's, Whitney's, Risdon's and others, its highest percentage of useful effect so far is 74.50 but there are no good reasons why it can not be made to go up with the others.

Wynkoop, Owosso, Michigan.

Gone to Junk Shop.

Davis, Warner, New Hampshire.

Gone after Wynkoop.

Tyler Scroll, Claremont, New Hampshire.

Too well known to require description; best result obtained by me with new 30-inch wheel 73.83, none of that style sold at that time, best result of such as he had been selling 67.04.

Josiah Buzby, Crosswick, New Jersey.

Wheel well made and would probably have done well in a proper curb but the chutes and gates were of the compound Fly-trap order with crooks and humps in all directions but the right ones; useful effect 66.13.

Cook Wheel, Lake Village, N. H. (Little Giant.)

Manufactured by B. J. Cole & Co. Changeable buckets, or buckets made separate from the rest of the parts and secured by bolts; Fly-trap gate. The last wheel tested was rather complicated but I understand that Mr. Cook has been making changes that are expected to improve the wheel materially. Highest percentage obtained was at three-fourths gate though of course more power was obtained at whole gate, best 74.9.

To Mr. Cook is due the credit of building the first wheel that gave its highest percentage at three-fourths gate, though others have not been slow to follow. Messrs. Cole & Co., are now enlarging facilities, and propose to take a higher place in the business.

Bastion, Canton, N. Y.

Imitation Houston; first wheel, Register Gate; second wheel, Wicket Gate; highest useful effect, 70.1.

Teller, Fort Plain, N. Y.

I think not manufactured now, probably gone to Junk Shop.

Gardiner Cox, Ellsworth, N. Y.

Spiral or twelve-threaded screw combined with Jonval, highest result 70 per cent., not manufactured now I think.

Asa Bee, Lancaster, Mass.

Wheel poorly made and bound in stuffing box, results unsatisfactory.

J. E. Stevenson, New York City, Duplex Turbine.

Experimental test to determine effect of changes.

Angell Wheel.

Manufactured by the Angell Wheel Co., Providence, R. I.

TEST OF A 40-INCH WHEEL, AT FITCHBURG, MASS., JULY 2, 1872.

Head in Feet.	Weir.	Rev. per Minute.	Weight.	Horse Power.	Cubic feet Disch'g'd.	Percentage.
21.80	10.85	240	260	28.36	1757.47	.3999
21.63	11.18	215	310	30.29	1837.70	.4034
20.90	14.00	156	510	36.16	2555.08	.3502
Tabled rate, same head,		280		about 103	about 2800	.9000

The dynamometer was placed upon horizontal shaft which was geared properly, according to tabled rate of speed of wheel, to run at 280 revolutions per minute. I was informed soon

after the trial that six buckets were broken. The wheel was nearly new, and as considerable less water was discharged than the tabled rate it would hardly seem probable that the buckets were sufficiently broken to leave the passages much open, certainly little reliance can be placed in Tables in circular until it has been submitted to a decisive trial. It has Fly-trap gates and is very leaky and was complained of at Fitchburg on that account. Since making that trial of its merits I have received letters from two other parties saying that the buckets of their wheels (the Angell) had broken off, though neither of the parties had heard of the Fitchburg trial.

Collins Wheel.

Manufactured by J. P. Collins & Co., Norwich, Ct. Is only made to order and local in reputation. A 24-inch, brass buckets, nicely finished wheel was sent to me recently to be tested. The sender stated that $900, had been paid for it and that Mr. Collins had sold it as the very best he could make. In accordance with my general practice Mr. Collins was notified of the matter with the time fixed for the trial. Two days in advance Mr. Collins put in an appearance very pleasantly remarking "*I acknowledge the right of every purchaser to ascertain by actual trial the value of any wheel purchased;*" he further stated that he had brought his overhauls in order to put the wheel in order if it was not in good condition. Indeed Mr. Collins was very genial and one may judge of my surprise the next morning when just as the wheel was deposited at my flume, Mr. Collins accompanied by sheriff, three or four appraisers, and other appurtenances of the law, stepped in with a writ of replevin and demanded the wheel. As I knew the purchaser had offered to sell the wheel for about a third of its price, I thought it an excellent sale, and, of course, made no unnecessary objections, but recalled to Mr. Collins his acknowledgment of the right of purchaser, to ascertain the value of wheel purchased; but was met with the statement that that particular wheel was not his present wheel at all; that he did not make such now, &c.; that he had no objection to his regular wheel being tested &c., &c. Now at the Philadelphia test, 1860, Mr. Collins produced the wheel that gave the lowest result of all, or about 47 per cent., as reported there, and as the wheel sent here was made somewhere

about two years since, as near as I can ascertain, it becomes a rather interesting point to ascertain when he commenced to make good wheels; and I wish to state here, that it is in my line of business to ascertain the value of every water-wheel or engine made as a motor; and whenever there is a chance to hitch to one, I shall do so, and report the exact results, sure.

Test of a 72-inch Blake Wheel.

These experiments were made to determine power required to drive Beating-engines, 36-inch rolls, paper and rag stock. Before testing the wheel, the speed of the main shaft was taken under different conditions, to ascertain the power required to drive machinery, the whole power of the wheel being required to drive the machinery at the following speeds, the water in the pond being one inch below the lowest part of the crest of the dam. When the tests were made with dynamometer, the water was flowing over the whole length of the dam, giving at least six inches more head than when speed of shaft was first obtained.

1st Trial.—3 Engines beating, 1 washing, and all machinery attached. Speed of main shaft, 120 revolutions per minute.

2d Trial.—2 Engines beating, 2 washing, all machinery attached. Speed of main shaft, 146 revolutions per minute.

3d Trial.—2 Engines beating, 2 washing, duster thrown off. Speed of main shaft, 160 per minute.

During the above trials the head was about 14 feet. The dynamometer was then applied to the end of main shaft, and the power of the wheel, at nearly same speed, obtained.

No. of Test.	Head.	Weight.	Rev. per Min.	Horse Power.
1	14.50	710	155	50 01
2	14.50	660	162.8	48.84
3	14.50	750	149.4	50.92
4	14.50	935	118	50.15
5	14.50	910	124.6	51.54

While getting ready to test with dynamometer, the pond filled up.

The third test with dynamometer gave 50.92 horse power, but the same speed of shaft when testing by machinery, was obtained with six inches less head, consequently the power then was 48.30. With the flush-boards off, leaving 13 feet head, under which the wheel was designed to give 60 horse power, its power would have been 43.16; but it had been in use eleven years. No attempt was made to measure the water, it simply took the whole river.

After testing the power of the water-wheel, the water was shut off, except enough to just turn it without transmitting any power, and the shaft was driven by a new and fine-looking steam engine, put into the mill to run the machinery in time of drouth. I think the engine had 15-inch cylinder, three feet stroke. It was guaranteed to give 60 horse power with 60 pounds of steam, but the dynamometer would only show 44 horse power, with a pressure of 65 to 70 pounds. There was one point developed while making the test, that was new to me. The driving-belt was heavy and well tightened, running direct from the fly-wheel of the engine to the large driving-pulley on the main shaft, of good length, and everything in as perfect condition as one could possibly ask for; yet when running the main shaft to the maximum power of the engine, there was a loss of about five revolutions per minute from slip of belt, the slip increasing rapidly with increase of weight on scale-beam. It may be thought that the engine was defective, but I believe that the application of the dynamometer will show steam engines to be as far below their rated power as many of the water-wheels are, not from any fault in the engine, but because through patent valves, "cut-offs," &c., a hundred pounds of power is expected from seventy-five pounds pressure of steam. It is merely a repetition of "stoves that heat rooms without any fuel."

It is not long since I tested the power of an engine "that was furnishing 150 horse power, with twenty hundred pounds of coal per day." The superintendent puffed the matter far and near, but the application of the dynamometer would only show 60 horse power. In two other cases I have found a remarkable difference between the power claimed and that actually transmitted. Trusting to the "Indicator" is the same, in principle, as measuring the water used by a water-wheel, to decide the amount of power furnished. One wheel transmits 35 per

cent., another 60 per cent., and another 85 per cent. I think it will be proved, in time, that a great deal of superfluous "perpetual motion" material has been worked up in the expansion theory, by those having little real knowledge of the subject, and to show the reliance to be placed in the report of Parlor Professors, I will here state that not long since I was employed as witness in a water-wheel suit. I had tested the power of the wheel previously, and as I was informed by the manufacturer that the agreement was that the wheel should transmit to the main line of shafting 109 horse power, I applied the dynamometer to the shaft as arranged by the wheel builder, and got 76 horse power, instead of 109; but when the case came on, the builder had a large supply of Professors on hand as witnesses. When placed on the stand, considerable time was spent in naming the honorary titles; why, if each had been printed and placed upon the owner, he would have been covered like a bill-sticker's bill-board in lecture time. Well, the defense was, that I should have applied the dynamometer directly to wheel shaft, and under oath the said Professors gave it as their positive belief that 21 per cent. of the power of the wheel was lost in transmission through a pair of bevel and a pair of spur gears. On returning home, a set of common gears were applied to the top of a Turbine shaft, in precisely the same way that the gears were connected with the wheel in controversy. The result may be seen below.

TEST OF WHEEL TO DETERMINE LOSS OF POWER IN TRANSMISSION THROUGH GEARS.

In making the experiments to determine the loss of power in transmission through gears, mitre gears twenty-seven inches in diameter, five-inch face fifty-seven teeth, were used on wheel and "jack-shaft," the last being six feet in length, and three inches in diameter; a spur gear twenty-four inches in diameter, four and one-half inch face, forty-four teeth, was secured upon the "jack-shaft," which worked into another gear, of the same size upon a second horizontal shaft, same size and length as the first, the second representing the main line of shafting through a mill, both horizontal shafts worked in common babbitted bearings. The dynamometer was placed upon the end of

the shaft representing the main line, and the wheel tested through the two pairs of gears; then upon the wneel shaft.

	Tests.	Head.	Revolutions.	Horse Power.	Percentage.
Dynamometer on horizontal shaft,	1st test,	16.03 feet.	160 per minute	26.55	75.90
Dynamometer on Wheel shaft,	2d "	16.08 "	168 "	26.73	77.40

Sherwood Wheel.

Manufactured by S. Sherwood, of Independence, Iowa. In reality, a fifty-five inch Fourneyron Wheel; can not say whether Mr. Sherwood claimed any part of it as new in principle, or not; but I can and do say that he acted like an honorable man, for as soon as he found the wheel was not one of the best in use, he abandoned it, as not proper to sell.

Rodney Hunt Machine Co., Orange, Mass.

RECENTLY HUNT, WAIT, & FLINT.

Owing to the unsettled state of affairs, naturally arising through the dissolution of the old, and the formation of the new Company, there was no trial of the Hunt, Wait & Flint Wheel at my flume, the past season, that would be proper to report, as the one sent from a purchaser was too powerful for the only dynamometer I had at the time; but the new Company have entered several wheels, to be tested, in the early spring, the results of which will be made public at the time. The new Company have also entered heartily into the agreement to sell by actual trial to any who desire. There is one point about their wheels worthy of imitation by other builders. They are thoroughly well made; but of all poor workmanship, water-wheel builders furnish the poorest I have ever seen done in a machine shop. A large share of the wheels furnished require rebuilding, or at least, much fixing after arriving at my flume, before they are fit to run, and in fact, before some of them will run, and one great advantage to the purchaser of buying a tested wheel is the certainty of its being in running condition. It is also equally advantageous to the builder for its exact merit is

known, and if it does not answer the expectation in the mill it is at once apparent that the wheel has not been properly set, or that more is required of it than is proper to expect. There is another point brought to mind by the foregoing, the benefit of ascertaining before purchasing a wheel, the amount of power necessary, and getting a suitable wheel for the purpose, instead of guessing at it as is generally the case. When the wheel business is established on a certain basis, as it readily may be by co-operation of builder and user, there will be no such letters given as may be found in the circulars issued by the very poorest wheel builders in the country. It is but a short time since I was handed one of the kind stating how a scroll wheel (the Chapman I believe,) had beaten the Swain; another of a remarkable increase of power obtained by replacing the Swain with a Leffel. Now, it is possible, in those particular cases, the Swain may have been poorly set, or what is also quite possible, poorly fitted, so that it bound in curb; but it is idle to talk seriously of any scroll wheel, three feet in diameter and upwards, or of any Leffel Wheel equalling the Swain when the latter is well made and properly set.

THOMPSON & HOLCOMB WHEEL.

This certifies that a Water Wheel, 30 inches in diameter, made of cast iron, fly-trap gates—downward discharge,—in form somewhat like the Houston, known as the Thompson Turbine, was sent to the Holyoke Testing Flume by A. P. Holcomb of Silver Creek, N. Y., to be tested. The figures showing the results obtained by me, may be found below. During the test, the scale beam was attached to the brake at a point, which, if revolving, would describe a circle fifteen feet in circumference, consequently the revolutions of the wheel must be multiplied by fifteen to obtain the correct speed.

Length of Weir, ... 6 feet.
Temperature of Water, ... 32° Fah.
Weight of Water, per cubic foot, ... 62.375.
Correction for Leakage, 18 feet head, ... 13.10 cubic feet.
Correction for Leakage, 12 feet head, ... 11.10 cubic feet.
Correction for Leakage, 6 feet head, ... 9.10 cubic feet.

A second trial of the same wheel to ascertain the effect of short extensions added to the outer end of chutes, for the purpose of rounding or flaring them when open. These extensions prevented the gates from being opened quite as wide as without them, consequently less water was discharged. The partial gate at first trial gave best percentage, but owing to a breakage of the gates by the ice at the second trial, no part gate tests could be taken.

The wheel run very steady, was easily regulated, and from its high speed is a favorite with those who have it in use; its gates, like the Leffel and all of that class, would be likely to become leaky.

No. of Test.	Head.	Weight	Rev. per Minute.	Horse Power.	Weir.	Cubic Feet.	Per Cent.
Whole Gate, 2	18.44	390	220.5	39.09	1.226	1547.76	.725
" 3	18.45	400	220	40.00	1.243	1579.39	.728
" 4	18.42	410	221	41.18	1.254	1599.95	.741
" 5	18.40	420	218	41.62	1.262	1614.97	.748
" 6	18.39	430	215	42.02	1.260	1611.20	.762
" 7	18.38	440	211	42.20	1.258	1607.46	.756
" 8	18.38	450	207.5	42.44	1.261	1613.09	.757
" 9	18.35	460	203	42.42	1.260	1611.20	.759
" 10	18.26	450	205.3	41.99	1.260	1611.20	.755
HEAD REDUCED.							
Whole Gate, 13	12.19	260	183	21.62	1.080	1285.96	.730
" 14	12.18	270	178	21.84	1.082	1289.47	.736
" 15	12.18	280	172	21.89	1.085	1294.75	.734
" 16	12.18	290	170	22.40	1.088	1300.03	.745
" 17	12.17	300	161.5	21.95	1.091	1305.30	.731
" 18	12.17	310	156.7	22.08	1.091	1305.30	.735
" 19	12.18	286	169.5	21.96	1.087	1298.27	.735
" 20	12.18	295	164	21.99	1.088	1300.03	.731
HEAD REDUCED.							
Whole Gate, 23	6.60	130	139	8.34	.875	940.26	.711
" 24	6.59	135	146	8.21	.878	948.28	.695
" 25	6.58	140	132.5	8.43	.876	945.08	.717
" 26	6.58	145	128	8.43	.877	946.68	.700
July 12th.							
Test of the same wheel before extensions were added.							
Whole Gate, 28	18.10	460	206	43.07	1.174	1713.41	.737
" 29	6.41	160	103.5	7.53	.800	974.88	.699
Part Gate, 30	18.25	400	203	36.60	1.040	1433.27	.742
" 31	18.33	325	208	30.70	.988	1280.52	.722
" 32	18.44	250	207	23.86	.818	1004.54	.673
" 33	18.50	200	207.5	18.86	.720	880.88	.651
" 34	6.60	125	102	6.26	.669	747.68	.678

HOLYOKE, MASS., December 18, 1872.

JAMES EMERSON.

CHASE WHEELS.

Experiments made for the Messrs. Stanwood, Tower & Co., at their paper mill at Gardiner, Me., a four ton mill, manilla, paper, jute stock.

The tests recorded on the opposite page were made to determine the relative power required to drive Beating engines.

The whole power of the 42-inch wheel was used to drive the Gould engine, the wheel making from 106 to 112 revolutions per minute, at which speed the engine easily did the work of four ordinary 40-inch Beating engines, furnishing pulp for two tons of paper per day.

One of the 54 inch wheels drove four 40-inch Beaters, the wheel making 61 and 62 revolutions per minute, the gate of the second wheel leaking sufficient to run the wheel and assist slightly in running the Beaters. Both wheels, at full gate, drove the four Beaters to 160 revolutions, the wheels making 120, at that speed the two wheels gave 109.64, H. P., against the 54 or 55 of the 42-inch wheel.

The 54-inch wheels were tabled and were geared to run at 138 revolutions per minute to give 112, H. P., actual results obtained, 43.91, while the percentage of useful effect from the water used could not have exceeded 25 per cent., but at 82 revolutions it might have reached 35 or 40.

The water in the race below the mill was 30 inches average depth, 29 feet in width, its velocity being so great as to cause it to break white, the fall being at least one foot in a hundred.

GOULD BEATING ENGINE.

As this engine is new, a description is herewith annexed.

The curb is cast iron, shaped like a watch case, the face opening representing the top, half of the curb being below the floor. Outside diameter 11 feet, depth 5 feet. The bed plate is circular, 3 feet inside and 5 feet outside diameter, placed in bottom like the lower mill stone, the Beater being affixed to the lower end of a vertical shaft and rotating like a burr stone, the Beater is driven by belt and pulley at top of shaft, though the Messrs. Newton's of this place are having two constructed to be driven by gears from below, the vertical shaft passing up through a stuffing box in the bottom of the curb. There is a valve of the usual size for discharging the pulp when ready for the machine.

A charge for the engine is about 60 barrels, which is prepared for paper machines in about three hours.

The centrifugal force keeps the pulp in constant motion, rendering stirring by hand unnecessary.

There is no loss from screenings, while it leaves a better fibre, consequently, as it costs less, takes less than one-fifth of the room, but half the power, makes better pulp, requires less help, etc., it takes at once with all who witness its operations.

JAMES EMERSON.

CHASE AND KNOWLTON WHEELS.

November 8, 1872.

CHASE WHEELS, FURNISHED BY THE ORANGE TURBINE CO., ORANGE, MASS.

No. of Test.	Head.	Weight.	Rev. per Minute.	Horse Power.
42-inch Wheel.				
Whole Gate, 1	15.17	500	194	44.09
" 2	15.17	700	161.5	51.17
" 3	15.17	750	158	53.86
" 4	15.17	800	149	54.18
" 5	15.17	850	143	55.25
" 6	15.17	900	135	55.22
" 7	15.17	950	128	55.27
" 8	15.17	1050	116	55.36
" 9	15.17	1100	104	52.00
54-inch Wheel.				
Whole Gate, 11	15.00	500	148	33.63
" 12	15.00	600	141	38.38
" 13	15.00	700	138	43.91
" 14	15.00	1000	117	53.20
" 15	15.00	1000	120.6	54.82
" 16	15.00	1050	118	56.32
" 17	15.00	1100	117	58.50
" 18	15.00	1200	112	61.09
" 19	15.00	1500	100	68.18
" 20	15.00	1800	90	73.63
" 21	15.00	2000	82	74.55

TEST OF A 60-INCH WHEEL, AT SACCARAPPA, ME., NOVEMBER 6, 1872.

No. of Test.	Head.	Weight.	Rev. per Minute.	Horse Power.
Whole Gate, 1	12.50	500	107	24.31
" 2	12.50	700	101	32.13
" 3	12.50	900	93	38.35
" 4	12.50	1000	89	40.30
" 5	12.50	1100	84	42.00
" 6	12.50	1200	80	43.63
" 7	12 50	1300	76	44.90
" 8	12.50	1500	69	47.04
" 9	12.50	1600	63	45.82
" 10	13.00	Would be		49.77

The above was called the Knowlton Wheel of Saccarappa, Me., having been constructed by a Mr. Knowlton of that place. The depth of the water in the flume, twelve and one-half feet, was given to me as the head, but I should judge that the head was several inches more, at least thirteen feet, from the appearance of the water where it left the timbers at the lower side of the mill, but whether twelve and a half or thirteen feet, the Wheel was evidently of inferior construction, the castings being too fragile for durability, the useful effect very low.

JAMES LEFFEL & CO., SPRINGFIELD, OHIO.

This certifies that a Water Wheel 30½ inches in diameter, made of cast iron—except lower buckets, which were of wrought iron—known as the James Leffel Double Turbine, was sent to be tested. The figures showing the exact results obtained by me, may be found below. During the test the scale beam was attached to the brake at a point which, if revolving, would describe a circle fifteen feet in circumference, consequently the revolutions of the wheel must be multiplied by fifteen to obtain the correct speed.

Length of Weir, 7 feet; correction for Weir level, —.015; temperature of Water, 33° Fah.; weight per cubic foot, 62.377.

No. of Test.	Head.	Weight.	Rev. per Minute.	Horse Power.	Weir.	Cubic Feet.	Per Cent.
Whole Gate, 1...	15.60	300	201	27.41	1.050	1429.12	.650
" 2...	15.56	310	197	27.76	1.058	1445.38	.653
" 3...	15.54	320	194	28.22	1.063	1455.57	.662
" 4...	15.525	330	190	28.50	1.064	1457.61	.666
" 5...	15.48	340	187	28.90	1.067	1463.74	.675
" 6...	15.44	350	184	29.27	1.068	1465.78	.684
" 7...	15.425	360	181.5	29.70	1.070	1469.87	.693
" 8...	15.42	370	180	30.27	1.070	1469.87	.707
" 9...	15.41	380	175	30.23	1.070	1469.87	.706
" 10...	15.405	390	175.5	31.11	1.072	1478.87	.725
" 11...	15.395	400	175	31.82	1.071	1471.92	.743
" 12...	15.38	410	168	31.31	1.070	1469.87	.733
" 13...	15.38	420	162.5	31.02	1.071	1471.92	.725
" 14...	15.38	430	161	31.47	1.071	1471.92	.735
" 15...	15.38	440	151.5	30.30	1.071	1471 92	.708
" 16...	15 38	450	143.5	29.35	1.072	1473 87	.685
" 17...	15.37	475	135.5	29.26	1.070	1469.87	.686
" 18...	15.38	400	159	28.91	1.065	1459.65	.681
" 19...	15.32	405	157.5	28.99	1.066	1461.76	.685
" 20...	15.33	410	155	28.89	1.067	1463.74	.681
" 21...	15.335	415	151	28.48	1.068	1465.78	.655
" 22...	15.345	420	151.4	28.90	1.069	1467.89	.679
" 23...	15.33	415	154	29.05	1.068	1465.78	.683
" 24...	15.33	425	146	28 20	1.065	1459.65	.667
" 25...	15.33	495	162	29.82	1.066	1461.69	.704
" 26...	15.31	400	158.5	28.94	1.066	1461.69	.690
" 27...	15.31	415	154	29.05	1.067	1463.74	.687
⅞ Gate, 28...	15.45	350	161	25.61	.985	1299.11	.675
¾ " 29...	15.65	300	161	21.95	.985	1106.73	.664
⅝ " 30...	15 785	240	161	17 56	.788	929.55	.648
½ " 31...	16.037	180	165	13 13	.676	737.42	.591
Whole Gate, 32...	15.57	650	Wheel still.		1.004		

In 1869 the Leffel Co., sent several highly-finished wheels to be tested, which gave nearly eighty per cent. useful effect, but the one recorded above was of the usual finish, such as is furnished the trade.

Several years ago the James Leffel wheel was one of the best in the market, but it is now surpassed by many others, and can only be rated as 3d class. Excessive leakage is its most objectionable feature.

JAMES EMERSON.

E. L. SMALL, URBANA, OHIO.

The results obtained may be found below. The peculiarity of the wheel consists in its gates and buckets, the gates being simply large faucets. The buckets are like shallow boxes,—Mr. Small believing angles better than curves for surfaces. As may be seen, his wheel gave great power for its size.

J. E.

No. of Test.	Head.	Weight.	Rev. per Minute.	Horse Power.	Weir.	Cubic Feet.	Per Cent.
Whole Gate, 1.....	18.39	480	181.6	39.62	1.148	1658.40	.688
" 2.....	18.40	540	170	41.72	1.147	1656.28	.725
" 3.....	18.39	570	149	38.61	1.147	1656.28	.675
" 4.....	18.29	580	147	38.75	1.147	1656.28	.677
" 5.....	18.28	555	169	41.09	1.148	1658.40	.720
" 6.....	18.28	540	169	41.48	1.148	1658.40	.724
" 7.....	18.28	545	165	40.88	1.148	1658.40	.714
" 8.....	18.28	550	165	41.25	1.148	1658.40	.718
Head Reduced. Gates Reversed.							
Whole Gate, 10.....	11.95	225	156	15.96	.916	1188.55	.595
" 11.....	12.03	310	136	19.34	.962	1276.38	.667
" 12.....	12.03	320	134.5	19.56	.962	1276.38	.674
Head Reduced.							
Whole Gate, 14.....	6.53	165	100	7.50	.776	934.87	.688
" 15.....	6.55	155	105	7.40	.769	915.44	.654
3-4 Gate, 17.....	18.52	330	170	25.50	.936	1227.15	.594
" 18.....	18.51	325	174	25.70	.937	1240.02	.599
" 19.....	18.52	340	170	26.27	.941	1235.35	.568
1-2 Gate, 21.....	18.72	150	170.2	11.60	.721	840.00	.391
" 22.....	18.60	180	171	13.68	.718	828.45	.471
4 Gates cl's'd, 24.....	18.51	270	170	20.86	.840	1043.90	.572

J. W. UPHAM, WORCESTER, MASS.

Mr. Upham has been in the Water Wheel business for many years, and is known for his sterling integrity. The wheel he now builds is one similar to the Houston Wheel inverted. It has a register gate that works very easily, as it is on the inside at the top and small. The figures below were obtained from trials at my Lowell Flume. The two last sets of figures are given to show the speed at which it may be run, and produce good power. The wheel that gave those results was afterwards used to drive machinery for drawing wire, and was pronounced unequalled for that purpose. Mr. Upham has spent much time and money experimenting, and proposes to continue until his wheel stands with the highest.

J. E.

No. of Test.	Head.	Weight.	Rev. per Minute.	Horse Power.	Weir.	Cubic Feet.	Per Cent.
Whole Gate, 1.....	15.43	250	238.5	27.10	.965	1259.83	.737
" 2.....	15.45	235	201.5	26.10	.945	1221.02	.732
" 3.....	15.46	310	193.5	27.27	.937	1205.59	.774
" 4.....	15.465	330	179.5	26.92	.932	1195.96	.770
" 5.....	15.42	275	216.5	27.06	.952	1234.58	.752
" 6.....	15.42	290	200.5	27.09	.944	1219.08	.763
" 7.....	15.42	300	198	27.00	.940	1211.36	.765
" 8.....	15.425	310	193.5	27.27	.936	1203.66	.777
" 9.....	15.42	320	186.5	27.13	.932	1195.96	.778
" 10.....	15.43	330	176.5	26.47	.928	1188.30	.764
" 11.....	15.39	300	198	27.00	.940	1211.36	.766
Tests of another wheel of the same kind.							
Whole Gate, 13.....	15.60	100	300	18.18	1.117	1319.08	.473
" 14.....	15.49	250	170	25.76	1.024	1175.01	.7502

TUTTLE, TYLER AND REYNOLDS WHEELS.

MESSRS. SMITH & MEADER : Gentlemen—Enclosed please find report of results obtained while testing the two wheels at your mill. The figures are doubtless several per cent. too high, as the water rushed over the weir, instead of flowing over it quietly, as it should have done. The highest results were obtained when the wheels were running at a speed impracticable for your business ; for at such speed the slightest extra obstruction (as, for instance, the saws striking a knot or a sudden increase in the size of the log) would stop the wheel at once. Such an irregularity is not an uncommon feature in water-wheels, and without doubt it might be overcome by changing the pitch of the buckets; but the gate arrangement should be discarded.

The people of your State are justly proud of the immense water-power contained within her borders; in justice to the water a better class of wheels should be used. I have enclosed results obtained at Vassalboro' from wheels used there. The Chase wheels, I think, are used more than any others; the Blake wheel (another of the same class) is also used to considerable extent. The Tyler, as now constructed by Mr. Tyler, is really an excellent wheel for places where the greatest economy of water is not required, as it is simple, cheap, and requires little attention. The Reynolds is objectionable from its great depth, which generally causes a loss of from one to three feet of head, unless the wheel-pit is extremely deep.

Yours truly,

JAMES EMERSON.

LOWELL, April 15, 1872.

This certifies, that on the 5th and 6th of this month, I tested, for Messrs. Smith & Meader, at their mill in Waterville, Me., two water-wheels, one 36 the other 48 inches in diameter. Four racks were used in the 36-inch wheel-pit, and seven in the other; these were used to break the force of the water, which left the wheels with so much unexpended force that it rushed to the weir with a much greater velocity than could be corrected by known formula. At high speed, the wheels were easily controlled, but when weights were added sufficient to reduce their revolutions to regulator standard, they became very unsteady, particularly the 48-inch wheel, which with more than 1000 pounds on scale beam, was hardly manageable, and the tests with more than that weight can only be considered approximations. In practical use the wheel, run at such speed, would be stopped with the slightest obstruction. These wheels are known as the "Tuttle Wheels," they are fitted with "Regulating Gate," which revolves with the wheel—a very objectionable arrangement on account of extravagant leakage caused by it, (65 cubic feet per minute from 48-inch wheel.) Result of tests may be found opposite.

Weir for 36-inch wheel 8 feet in length, depth below crest 1.250, width of pit 10.708. Weight of cubic foot of water 62.380.

Weir for 48-inch wheel 10 feet in length, depth below crest, 1.687, width of pit 13.167.

JAMES EMERSON.

LOWELL, MASS., April 15, 1872.

This certifies, that on the 8th and 9th of this month I tested two 42-inch water-wheels at the Vassalboro' Woolen Mills, Vassalboro', Me., George Wilkins, Agent.

The first was called a Tyler wheel, though not made or furnished by Mr. Tyler. Regulator speed of wheel 170 revolutions per minute. The test proved that it was run at a velocity much too high to utilize its greatest effectiveness.

Second wheel, a "Reynolds." Testing first with gate open the same as when running all the machinery attached to it, six tests; then the gate was opened in full; with 1100 pounds on the scale beam the wheel ran very unsteadily, so much so that it was considered useless to try it with more weight.

Results of tests of both wheels may be found opposite.

Weir 10 feet in length, sectional area approaching weir 25 feet in width, depth below crest 2.5 feet.

April 15, 1872.

JAMES EMERSON.

TESTS OF A 36-INCH AND OF A 48-INCH TUTTLE WHEEL AT SMITH & MEADER'S MILL, WATERVILLE, ME.

36-inch. No. of Test.	Rev. per Minute.	Weight in Pounds.	Horse Power.	Head in Feet.	Weir.	Cubic Feet Disch'd	Per Cent.
Whole Gate, 1...	190.8	425	36.86	15.85	1.438	2748.83	.4479
" 2...	187.5	450	38.35	15.89	1.430	2725.02	.4685
" 3...	183.4	475	39.60	15.86	1.437	2744.10	.4814
" 4...	179.4	500	40 77	15.84	1.453	2787.87	.4998
" 5 .	176	525	42.00	15.83	1.454	2793.36	.5025
" 6...	172	550	43.00	15 84	1.454	2793.36	.5141
" 7...	168.5	575	44.04	15.84	1.452	2782.39	.5286
" 8...	164	600	44.73	15.85	1.447	2771.43	.5262
" 9...	160	625	45.45	15.86	1.446	2768 70	.5463
" 10...	164.5	590	44.12	15.89	1.449	2776.91	.5290
" 11...	162.6	600	44.32	15.84	1.450	2779.65	.5325
" 12...	161	615	45.01	15.79	1.446	2768.70	.5572
Part Gate, 13...	175	325	25.82	16.58	1.250	2227.83	.3698
" 14...	168	130	9.93	17.22	.963	1489.98	.2066
48-inch.							
Whole Gate, 1...	148.4	900	60.71	14.53	1.634	4135.02	.5243
" 2...	145.8	900	59.66	14.54	1.630	4145.97	.5230
" 3...	148	875	58.86	14.47	1.630	4145.97	.5190
" 4...	149	850	57.56	14.46	1.630	4145.97	.5075
" 5...	150.2	825	56.32	14.45	1.627	4131.37	.4992
" 6...	143.5	925	60.33	14.55	1.630	4145.97	.5291
" 7...	142	950	61.31	14.47	1.632	4149.62	.5409
" 8...	140	1000	63.63	14 47	1.630	4145.97	.5612
" 9...	138.5	1025	64.53	14.45	1.630	4145.97	.5831
" 10...	137	1050	65.38	14.48	1.632	4149.62	.5625
" 11...	130	1100	65.00	14.48	1 630	4145.97	.572
" 12...	125	1150	66.38	14.48	1.632	4149.62	.57!
⅓ Gate, 13...	161	425	31.11	15.73	1.312	2992.99	.349

TESTS OF A 42-INCH TYLER, AND A 42-INCH REYNOLDS WHEEL, AT VASSALBORO' WOOLEN MILLS, VASSALBORO', ME.

Tyler. No. of Test.	Rev. per Minute.	Weight in Pounds.	Horse Power.	Head in Feet.	Weir.	Cubic Feet Disch'd.	Per Cent.
Whole Gate, 1...	168.6	700	53.65	27.21	1.264	2609.50	.3999
" 2...	164.4	750	56.05	27.21	1.282	2664.84	.4089
" 3...	160.8	800	58.47	27.21	1.282	2664.84	.4266
" 4...	144.6	1100	72.30	27.21	1.297	2776.10	.5063
Reynolds.							
Part Gate, 1...	139	800	50.54	28	1.210	2436.82	.3918
" 2...	168.5	750	57.44	28	1.210	2436.82	.4453
" 3...	172.5	775	57.74	28	1.210	2436.82	.4477
" 4...	173.5	800	63.09	28	1.210	2436.82	.4892
" 5...	161	850	62.20	28	1.210	2436.82	.4823
" 6...	149.6	900	61 20	28	1.210	2436.82	.4745
Whole Gate, 7...	166	1000	75.45	28	1.297	2776.10	.4683
" 8...	161.6	1100	80.80	28	1.297	2776.10	.5015

N. F. BURNHAM'S "NEW TURBINE."

This certifies, that a Water Wheel 36 inches in diameter, made of cast iron, "Downward discharge," "Register gate," known as N. F. Burnham's "New Turbine," was sent to the Holyoke Testing Flume by N. F. Burnham of York, Pa., to be tested. The date of each test and the figures showing the exact results obtained by me, may be found on the next page. During the test the scale beam was attached to the brake at a point, which, if revolving, would describe a circle fifteen feet in circumference, consequently the revolutions of the wheel must be multiplied by fifteen to obtain the correct speed.

Length of Weir,	7 feet.
Temperature of Water,	77° Fah.
Weight of Water per cubic foot,	62.217.
Correction for Leakage, 18 feet head,	19.50 cubic feet.
Correction for Leakage, 12 feet head,	18.50 cubic feet.
Correction for Leakage, 6 feet head,	17.50 cubic feet.

These experiments were witnessed by Prof. Thurston of the Stevens Institute, engineers E. M. Wright, Fort Edward, N. Y., S. Webber, Manchester, N. H., and many others well versed in Turbine Wheels, the results were then considered exceedingly good, but more recent experiments have rather eclipsed them. N. F. Burnham, however, is not one likely to remain long obscured where emergence is possible, he has already constructed a Testing Flume and several experimental wheels for the purpose of determining the form of buckets that will transmit the greatest percentage of power of the water used. His wheel embraces the same principles as the Risdon, differing in length of chutes and other details, thus leaving it a matter of brains, whether the Burnham or Risdon Wheels shall produce the highest results. As may be seen the wheel gives great power for its size, it is simple in construction, well made, and sold below the prices asked for many of the worthless things advertised as the "best wheel in the world."

JAMES EMERSON.

HOLYOKE, MASS., August 14, 1872.

No. of Test.	Head.	Weight.	Rev. per Minute.	Horse Power.	Weir.	Cubic Feet.	Per Cent.
Whole Gate, 1...	18.09	750	156	53.18	1.308	1994.52	.7824
" 2...	18.12	800	151	54.91	1.309	1996.77	.787
" 3...	18.10	810	150	55.22	1.311	2001 27	.808
" 4...	18.10	820	148	55.16	1.312	2003.58	.807
" 5...	18.10	830	147	55.46	1.313	2005.78	.819
" 6...	18.09	840	143.5	52.25	1.316	2012.55	.761
2 chutes stopped with blocks, 7...	18.30	680	146.4	45.25	1.200	1755.97	.747
3 chutes stopped with blocks, 8...	18.30	615	146.4	40.93	1.147	1642.74	.722
4 chutes stopped with blocks, 9...	18.22	500	147.2	33.47	1.062	1464.92	.665
6 chutes stopped with blocks, 10...	18.49	365	147	24.39	.919	1180.30	.579
Whole Gate, 11...	18.11	830	146.4	55.23	1.327	2037.41	.794
Part Gate, 12...	18.20	680	147.4	45.56	1.226	1812.58	.733
Without bl'ks, 13...	18.25	615	145	40.53	1.178	1708.50	.689
Whole Gate, 14...	18.29	500	146	33.18	1.082	1505.95	.639
" 15...	18.37	365	146	24.35	.959	1252.11	.567
Head Reduced.							
Whole Gate, 17...	12.14	450	137	28.02	1.120	1586.21	.772
" 18...	12.15	475	133.5	28.82	1.127	1600.95	.778
" 19...	12.13	500	128.5	29.21	1.134	1615.71	.773
" 20...	12.13	525	123.5	29.47	1.139	1626.29	.792
" 21...	12.11	550	117	29.25	1.143	1634.77	.784
" 22...	12.09	575	115	30.05	1.151	1651.76	.798
Unreliable, 23...	12.12	520	124.5	29.42	1.135	1615.83	.800
Whole Gate, 24...	12.11	530	123	29.63	1.141	1630.53	.796
" 25...	12.10	540	120.5	29.59	1.143	1634.77	.793
" 26...	12 10	550	118	29.50	1.145	1639.01	.789
" 27...	12.09	560	117	29.78	1.147	1643.26	.795
" 28...	12.09	570	115.5	29.92	1.150	1649.83	.796
" 29...	12.09	580	113.5	29 92	1.154	1658.15	.792
" 30...	12.08	590	110	29.50	1.158	1667.67	.779
" 31...	12.07	600	109.5	29.86	1.160	1670.94	.785
" 32...	12.06	610	107.5	29.77	1.162	1675.21	.782
" 33...	12.10	560	115	29.27	1.146	1641.13	.782
" 34...	12.10	565	114.5	29.41	1.150	1649.63	.780
" 35...	12.10	570	114	29.54	1.151	1651.76	.784
Head R duced.							
Whole Gate 36...	6.33	300	80	10.91	.924	1191.93	.767
" 37...	6.33	295	81	10.86	.922	1188.08	.766
" 38...	6.33	290	83	10.94	.920	1184.23	.774
" 39...	6.34	285	84.5	10 97	.919	1179.90	.778
" 40...	6.35	280	86.5	11 80	.917	1178.46	.780
" 41...	6.36	275	87.5	10.94	.915	1174.62	.779
" 42...	6.37	270	89	10.92	.912	1168.87	.778
" 43...	6.37	265	90	10.84	.910	1165.04	.775
" 44...	6.37	260	92	10.79	.909	1163.12	.772
" 45...	6.38	255	92.5	10.42	.907	1159.30	.747

RISDON TURBINE.

This certifies, that a Water Wheel, 36 inches in diameter, made of cast iron, downward discharge, known as the Risdon Turbine, was sent to the Holyoke Testing Flume by T. H. Risdon & Co., Mount Holly, New Jersey, to be tested. The date of each test and the figures showing the exact results obtained by me, may be found on the opposite page. During the test the scale beam was attached to the brake at a point, which, if revolving, would describe a circle fifteen feet in circumference, consequently the revolutions of the wheel must be multiplied by fifteen to obtain the correct speed. Data, for one minute, though the experiments were longer in duration:

Length of Weir,	7 feet.
Temperature of Water,	62° Fah.
Weight of water, per cubic foot,	62.321.
Correction for Leakage, 18 feet head,	11 cubic feet.
Correction for Leakage, 12 feet head,	9 cubic feet.
Correction for Leakage, 6 feet head,	7 cubic feet.

HOLYOKE, MASS., 1872.

REMARKS.

The results, obtained September 18, were so extraordinary that Mr. Risdon was requested to invite James B Francis of Lowell and H. F. Mills of Lawrence, to witness the experiments, but these well known engineers were unable to attend, but Mr. Francis kindly suggested a more accurate method than had previously been used for determining the leakage of the flume; his plan was adopted, and the instruments were perfectly adjusted by the engineers, whose certificate may be seen below. The examination proved the weir to be 7.007 feet in length instead of exactly 7 feet, the point of the hook gauge to be .004 too high, which errors favored the wheel, while the point at which the scale beam was attached to the brake was slightly against the wheel, the errors being perfectly corrected the tests under date of September 20 were then made. The wheel was plain cast iron, cast in one piece, in a curb that has since been abandoned, Mr. Risdon expecting to show still higher results in a different curb, and if skill, perseverance, and a practical method of doing business entitle one to be successful he is certainly likely to be so.

JAMES EMERSON.

Holyoke, September 20, 1872.

We, the undersigned, hereby certify that we have witnessed the observations recorded on the opposite page of a test of a 36-inch Turbine made by T. H. Risdon & Co., Mount Holly, N. J., and hereby certify that we measured the Weir, adjusted the hook gauge and measured the dynamometer, and that the instruments and adjustment were correct for the tests made September 20, and that the observations made on same day and herewith recorded are correct.

N. H. WHITTEN, Holyoke.
A. R. GRAVES, Chicopee.
WM. A. CHASE, Holyoke.

No. of Test.	Head.	Weight.	Rev. per Minute.	Horse Power.	Weir.	Cubic Feet.	Per Cent.
Sept. 18th.							
Whole Gate, 1...	18.25	700	163.5	52.02	1.193	1749.33	.863
" 2...	18.25	750	151.5	51.65	1.201	1766.64	.850
" 3...	18.28	705	162.5	52.07	1.196	1755.81	.859
" 4...	18.28	710	162	52.28	1.196	1755.81	.863
" 5...	18.30	715	160	52.00	1.199	1762.29	.854
" 6...	18.32	720	159.6	52.20	1.199	1762.29	.856
" 7...	18.34	725	158.6	52.26	1.200	1764.47	.854
" 8...	18.33	730	157.6	52.29	1.201	1766.64	.855
" 9...	18.32	735	156.5	52.29	1.202	1768 81	.854
" 10...	18 32	740	155.5	52.30	1.201	1766.64	.856
" 11...	18.34	745	155	52.48	1.202	1768.81	.857
" 12...	18.32	750	153	52.16	1.203	1770.98	.832
" 13...	18.34	760	149.5	51.65	1.203	1770.98	.842
" 14...	18.34	690	167	52.37	1.199	1762.29	.858
" 15...	18.34	680	169	52.24	1.198	1760.13	.857
" 16...	18.35	670	171.5	52.22	1.197	1757.97	.858
1 Pt. closed, 18...	18.51	560	154	39.20	1.047	1442.53	.779
" 19...	18.51	545	158	39.14	1.045	1438.45	.778
2 Pts. closed 21..	18.85	190	162	13.99	.723	831.05	.473
Whole Gate, 22...	18.37	745	154.6	52.35	1.200	1764.47	.855
Head Reduced.							
Whole Gate, 24...	12 03	400	146.7	25.46	1.026	1400.89	.800
" 25...	12.03	425	140	27.04	1.029	1405.96	.847
" 26...	12.01	450	133	27.20	1.033	1415.06	.848
" 27...	12.01	460	128.5	26.86	1.036	1421.15	.833
" 28...	12.09	470	126	26.92	1.037	1423.18	.835
" 29...	12.00	455	131	26.79	1.032	1413.04	.837
" 30...	12.00	445	134	26.80	1.030	1408.98	.842
Head Reduced.							
Whole Gate, 32...	6.46	200	109.2	9.95	.823	1010.67	.807
" 33...	6.43	225	99.5	10.17	.830	1023.49	.820
" 34...	6.43	230	98	10.25	.830	1023.49	.823
" 35...	6.43	235	95.5	10.20	.831	1025.33	.8192
" 36...	6.43	240	93	10.14	.832	1027.17	.813
Sept. 20th.							
Whole Gate. 38...	18.30	675	170	52.16	1 197	1759.65	.838
" 39...	18.32	700	165	52.50	1.200	1766.24	.8591
" 40...	18.33	725	159	52.40	1.202	1770.58	.857
" 41...	18.35	745	154	52.15	1.204	1774.92	.850
" 42...	18 33	705	162.7	52.14	1.201	1768.41	.852
" 43...	18.33	710	162 5	52.44	1.201	1768.41	.857
" 44...	18.32	690	167.4	52.50	1.200	1766.24	.8591
" 45...	18.32	680	169.5	52.39	1.199	1764.08	.858

NATIONAL WATER WHEEL CO., BRISTOL, CONN.

This certifies that a Water Wheel, 40 inches in diameter, made of cast iron, downward and central discharge, Register Gate, known as the J. T. Case water wheel, was sent to the Holyoke Testing Flume, by the National Water Wheel Co., Bristol, Connecticut, to be tested. The figures showing the results obtained by me, may be found on the opposite page. During the test the scale beam was attached to the brake at a point, which, if revolving, would describe a circle fifteen feet in circumference, consequently the revolutions of the wheel must be multiplied by fifteen to obtain the correct speed. Data for one minute.

Length of Weir,	10 feet.
Temperature of Water,	32° Fah.
Weight of Water, per cubic foot,	62.375.
Correction for Leakage, 18 feet head,	54 cubic feet.
Correction for Leakage, 12 feet head,	52 cubic feet.
Correction for Leakage, 6 feet head,	50 cubic feet.

The curb of this wheel has sixteen ports or chutes, four occupying one-eighth of the circumference of the curb on each quarter—an equal space in blank between—in order that the gate when open may leave the chutes clear, or a part of them as required, thus constructed, for the purpose of obtaining high part gate results. It was in such a curb that T. H. Risdon obtained his high results and abandoned because the Case patent covered it.

Mr. Case first constructed wheels resembling the Houston in form, but not in useful effect, then one similar to his present plan, but more complicated, it having a double or compound Register Gate, which was soon abandoned for the kind now manufactured by the National Water Wheel Co. Two of the kind resembling the Houston, were tested by me earlier in the season, each giving about 47 per cent useful effect. Several of the kind with compound gate were also tested, giving results somewhere in the sixties; then a 20 inch of the latest plan. which, for its size gave good results, particularly on "quarter gate." This explanation is made because some of the first wheels are still in use. and might prejudice the sale of such as are now made. The honorable intentions of the company may be judged from the fact that as soon as the experiments proved the deficiencies of the first wheels, they were immediately broken up instead of being sold. While there on business, I noticed forty finished wheels that were tumbled out back of the shop ready for the foundry. The liberality of the company has enabled Mr. Case to "cut" *and to "try"* in a way to determine the effect, instead of to cut but *not to try*, or if tried done entirely at the purchaser's expense, and the effect guessed at as has been, and still is the case with the whole wild-cat fraternity.

The Case wheel is well made, and sold at a reasonable price. The company enter heartily into the plan of selling wheels on their merits, as shown by actual trial of each wheel sold. The figures opposite show what has been done, and the company propose to go higher before the season closes. J. E.

J. T. CASE WHEEL.

No. of Test.	Head.	Weight.	Rev. per Minute.	Horse Power.	Weir.	Cubic Feet.	Per Cent.
Whole Gate, 1...	17.85	600	174	47.42	1.046	2038.74	.689
" 2...	17.82	620	178	50.16	1.050	2050.56	.7.6
" 3...	17.78	650	168.5	49.78	1 054	2061.36	.719
" 4...	17.75	675	165	50.62	1.057	2070 32	.729
" 5...	17 73	700	162.5	51.70	1.064	2092.16	.737
" 6...	17.70	725	160	52.72	1.070	2110.10	.747
" 7...	17.69	750	157	53.52	1.074	2122.10	.754
" 8...	17.67	775	155	54.60	1.080	2140.06	.764
" 9...	17.63	800	153	55.63	1.084	2152.08	.776
" 10...	17.62	825	150	56.25	1.088	2163.51	.781
" 11...	17.62	850	146	56 41	1.088	2163.51	.783
" 12...	17.61	875	144	57.27	1.090	2170.14	.793
" 13...	17 60	900	142	55.09	1.096	2188.26	.774
" 14...	17.58	925	132	55.50	1.100	2200.36	.759
" 15...	17.58	950	123	53 11	1.104	2212.48	.722
Head Reduced.							
Whole Gate, 17...	12.15	650	111	32.79	.972	1825.86	.782
" 18...	12.14	625	117	33.24	.970	1819.74	.796
" 19...	12.15	600	118.5	32.32	.968	1814 02	.776
" 20...	12.17	575	122.5	32.01	.965	1805.47	.771
" 21...	12.15	615	117	32.71	.969	1816.97	.784
" 22...	12.14	635	115	33.19	.972	1825.86	.792
Head Reduced.							
Whole Gate 24...	6 74	350	84	13.36	.802	1361.90	.770
" 25...	6.71	360	80.8	13.22	.803	1364.51	.765
" 26...	6.70	370	77.5	13.00	.805	1369.84	.749
" 27...	6.73	340	86	13.29	.801	1359 39	.769
" 28...	6 75	330	87	13.05	.800	1356.78	.754
Part Gate,							
12 p'ts op'n, 30...	17.84	800	132.6	48.22	.944	1743.95	.820
8 " " 31...	18 04	400	134	24.36	.730	1173.98	.609
8 " " 32...	18 41	350	142	22.48	.712	1129.28	.560
8 " " 33...	18.32	500	120	27 27	.749	1221.74	.646
4 " " 34...	18 94	150	139	9.48	.512	670.49	.395

AMERICAN OR DAYTON TURBINE.

This certifies that a Water Wheel, 36 inches in diameter, made of cast iron with wrought iron buckets, centre discharge, known as the American or Dayton Turbine Water Wheel, was sent to the Holyoke Testing Flume by Messrs. Stout, Mills & Temple, Dayton, Ohio, to be tested. The date of each test and the figures showing the exact results obtained by me, may be found on the opposite page. During the test the scale beam was attached to the brake at a point, which, if revolving, would describe a circle fifteen feet in circumference, consequently the revolutions of the wheel must be multiplied by fifteen to obtain the correct speed. Data for one minute, though the tests were of longer duration :

Length of Weir,	10 feet.
Temperature of Water,	40° Fah.
Weight of Water per cubic foot,	62.382
Correction for Leakage, 19 feet head,	17.80 feet.
Correction for Leakage, 12 feet head,	15.80 feet.
Correction for Leakage, 6 feet head,	13.80 feet.

HOLYOKE, MASS., 1872.

REMARKS.

The following paragraph is copied from a circular recently issued by Messrs. Stout, Mills & Temple.

"Accordingly we forwarded one of our New and Improved Wheels, 36 inches in diameter—just such a wheel as we would ship any customer—and on the 20th day of November, 1872, the testing of this wheel was completed. During the testing, several experts whom we had invited to witness the tests were present, but James Emerson gave all the data, and with his able assistant made all the calculations and furnished the results, and while in the act of handing us the paper containing the data and the percentage of useful effect, Mr. Emerson remarked, '*These are the best average results ever given by any Turbine Wheel in my experience.*'"

The above, so far as it relates to myself, is correct, the results recorded on the opposite page prove the wheel to be the best yet tested for places where the supply of water is limited and extremely variable, and if discretion in selection is used, the peculiarity of highest percentage being obtained at three-fourths gate may be made very useful. Of course the reverse would be the case where the wheel is to be run to its full capacity the most of the time. The curb, with its gate arrangement, seems to be the best in use for general application, but I believe very much better results could be obtained by the use of a different wheel.

JAMES EMERSON.

HOLYOKE, MASS.

STOUT, MILLS & TEMPLE, DAYTON, OHIO.

No. of Test.	Head.	Weight.	Rev. per Minute.	Horse Power.	Weir.	Cubic Feet.	Per Cent.
Whole Gate, 1...	19.00	670	156.7	47.72	.930	1740.80	.764
" 2...	19.02	680	155	47.91	.932	1746.41	.763
" 3...	19.01	690	153	47.99	.934	1752.02	.762
" 4...	19.02	700	152.5	48.52	.936	1757.63	.768
" 5...	19.02	710	150	48.41	.938	1763 25	.764
" 6...	19.01	720	148	48.43	.939	1766.06	.763
" 7...	19.01	730	146 5	48.61	.940	1768.87	.765
" 8...	19.01	740	145	48.77	.942	1774.51	.767
" 9..	19.00	750	144	49.09	.944	1780.14	.768
" 10...	19.00	760	142.4	49.20	.947	1788.61	.766
" 11...	19.01	770	140	49.00	.949	1793.66	.760
" 12..	19.01	780	139	49.28	.950	1797.09	.763
" 13...	19.00	790	137.5	49.37	.951	1799.92	.764
" 14...	19.01	800	135.4	49.23	.952	1802.75	.760
" 15...	19.01	810	132.7	48.86	.953	1805.58	.753
" 16...	19.01	785	138	49.24	.947	1788.61	.766
" 17...	19.01	795	136.7	49.40	.950	1797.09	.765
Part Gates,							
7/8 19...	19.05	720	138	45.16	.873	1587.48	.790
7/8 20 ..	19.03	700	140	44.54	.863	1556.37	.796
7/8 21...	19.04	710	139	44.55	.868	1569.91	.788
3/4 22...	19.11	615	140.3	39.22	.785	1350.02	.804
5/8 23...	19.21	500	139.7	31.44	.695	1123.75	.770
1/2 24...	19.30	350	146.5	23.31	.595	888.29	.719
3/8 25...	19.41	250	142	16.13	.496	691.16	.636
1/4 26...	19.53	120	146	7.96	.373	451.75	.477
27...	19.11	000	256.5	00.00	.737		.000
Head Reduced.							
Whole Gate, 29...	12.37	480	114	24.87	.823	1451.39	.733
" 30...	12.35	490	112	24.94	.827	1461.98	.731
" 31...	12.37	475	117	25.26	.819	1440.83	.750
" 32...	12.36	485	114.5	25.24	.823	1451.39	.744
" 33...	12.35	495	111.5	25.01	.826	1459.33	.734
" 34...	12.35	505	109.5	25.13	.827	1461.98	.736
" 35...	12.58	450	125.5	25.67	.817	1435.46	.752
" 36...	12.58	460	122	25.51	.820	1443.47	.743
" 37...	12.57	470	121	25.85	.822	1448.75	.751
Head Reduced.							
Whole Gate, 39...	6.93	220	101.5	10.15	.657	1036.24	.748
" 40...	6.91	230	96	10.03	.662	1048.13	.733
" 41...	6.93	215	101.5	9.92	.657	1036.24	.731
" 42...	6.92	225	99	10.12	.661	1045.75	.740
" 43...	6.90	240	92.3	10.07	.667	1060.08	.729
" 44...	6.91	222.5	99	10.01	.660	1045.29	.733

STILWELL & BIERCE MANUFACTURING CO.,
Dayton, Ohio.

This certifies that a Water Wheel 25 inches in diameter, made of cast iron, known as the Eclipse Double Turbine, was sent to the Lowell Testing Flume by the Stilwell & Bierce Manufacturing Co., of Dayton, Ohio, to be tested. The figures showing the exact results obtained by me, may be found below. During the test the scale beam was attached to the brake at a point which, if revolving, would describe a circle twenty feet in circumference, consequently the revolutions of the wheel must be multiplied by twenty to obtain the correct speed.

Length of Weir, 6 feet; correction for Weir level,—.0145; temperature of water, 71; weight of water per cubic foot, 62 364.

No. of Test.	Head.	Weight.	Rev. per Minute.	Horse Power.	Weir.	Cubic Feet.	Per Cent.
Whole Gate, 1.....	15.15	270	000	000	.895	961.40	.000
" 2.....	15.15	100	234	14.18	.895	961.45	.515
" 3.....	15.145	110	227.6	15.17	.906	979.00	.542
" 4.....	15.14	120	221.4	16.10	.915	993 66	.567
" 5.....	15.190	130	216	17.02	.921	1003.40	.592
" 6.....	15.20	140	208.2	17.67	.927	1013.16	.609
" 7.....	15.235	150	197.4	17.95	.932	1021.33	.611
" 8.....	15.235	160	186.6	18.09	.938	1029.75	.611
" 9.....	15.23	170	176.5	18.18	.942	1037.71	.610
" 10.....	15.235	180	168.5	18.30	.948	1047.60	.603
" 11.....	15.235	190	161	18.54	.954	1057.49	.610
" 12.....	15.24	200	152	18.42	.953	1055.84	.607
" 13.....	15.24	210	147	18.71	.955	1059.14	.6143
" 14.....	15.24	220	133	17.73	.952	1054.19	.586
" 15.....	15.735	125	233.2	17.67	.925	1009.89	.589
SECOND DAY.							
Unreliable, 16.....	15.735	140	223.4	18.96	.918	998.52	.636
Unreliable, 17.....	15.73	150	227.6	20.69	.916	995.28	.700
Whole Gate, 18.....	15.73	160	211.2	20.48	.933	1022.97	.675
" 19.....	15.73	170	203.4	20.96	.937	1029 51	.686
" 20.....	15.725	180,	193.6	21.12	.942	1037.71	.686
" 21.....	15.725	190	181	20.84	.942	1037.71	.678
" 22.....	15.72	200	171.4	20.78	.952	1054.19	.665
" 23.....	15.72	210	160.6	20.44	.957	1062.44	.649
" 24.....	15.72	220	151.5	20.20	.957	1062.44	.641
" 25.....	15.71	230	137	19.10	.959	1065.75	.605
" 26.....	15.695	240	120.5	17.53	.959	1065.75	.555
" 27.....	15.695	250	119	17.74	.961	1069.06	.560
" 28.....	15.81	175	195	20.68	.950	1050.88	.660
" 29.....	15.792	177.5	191.6	20.61	.951	1052.53	.657
" 30.....	15.80	180	189.6	20.68	.952	1054.18	.658
" 31.....	15.80	182.5	187	20.68	.953	1055.83.	.657
" 32.....	15.81	185	184.6	20.70	.954	1057.48	.656
" 33.....	15.795	187.5	182.4	20.73	.955	1059.14	.6568
" 34.....	15.795	190	181.4	20.89	.956	1060.80	.6563
" 35.....	15.795	192.5	178.3	20.80	.957	1062.44	.6563
" 36.....	15.795	195	175.6	20.75	.958	1064.10	.654
" 37.....	15.80	197.5	173.8	20.80	.959	1065.75	.655
" 38.....	15.80	200	171	20.73	.960	1067.41	.651
" 39.....	15.795	190	180.8	20.82	.956	1060.80	.659
7-8 Gate 40.....	15.91	135	191.8	15.69	.840	875.95	.5967
3-4 " 41.....	15.96	107.5	194.2	12.65	.782	785.44	.5748
1-2 " 42.....	16.20	135	194.4	4.43	.595	519.95	.28

JAMES EMERSON.

LOWELL, MASS., August 20, 1871.

B. J. BARBER, BALLSTON SPA, N. Y.

[From my Report of 1871.]

"B. J. Barber of Ballston Spa, N. Y., has made a combination that works well; so well, indeed, as to cause manufacturers to think seriously of exchanging the expensive Fourneyron Wheels as built by Mr. Boyden for it. The combination consists of a wheel like the Warren, (which was a favorite fifteen years ago, and now may be seen back of many a mill in New England, where it has been thrown to make room for better wheels) and a re-action wheel underneath for the purpose of utilizing the remaining power of the water after it has passed the upper wheel. This is a theory upon which much time and money has been expended. Mr. Barber is working upon a more decisive plan than theorists generally do, for he has built a testing flume and procured complete testing apparatus in order to work understandingly."

My experience has not caused me to believe in "Double Wheels," but the figures below would have been considered exceedingly good five years since, and they are certainly higher than can be obtained from any other "Double Wheel" of common finish with which I am acquainted. I think it would be better to build it stronger, even if necessary to raise the price, which is low. Mr. Barber has no relationship to the wild-cat fraternity, he will never claim 90 per cent until sure that his wheel utilizes that proportion of the power of the water used.

No. of Test.	Head.	Weight.	Rev. per Minute.	Horse Power.	Weir.	Cubic Feet.	Per Cent.
Whole Gate, 1.....	18.80	380	198.5	34.28	1.081	1279.46	.756
" 2.....	18.84	390	196.3	34.80	1.085	1286.49	.760
" 3.....	18.87	400	195	35.45	1.089	1293.53	.768
" 4.....	18.88	410	191.5	35.69	1.091	1297.07	.783
" 5.....	18.60	400	192	34.91	1.083	1282.98	.778
" 6.....	18.60	410	189	35.25	1.088	1291.77	.778
" 7.....	18.60	420	186.5	35.63	1.090	1295.30	.783
" 8.....	18.60	430	181.5	35.47	1.092	1293.15	.777
" 9.....	18.61	440	181	36.20	1.096	1305.90	.788
" 10.....	18.60	450	177	36.18	1.098	1300.44	.788
" 11.....	18.59	445	178	36.04	1.096	1305.90	.785
" 12.....	18.58	435	181.5	35.89	1.094	1302.30	.785
" 13.....	18.60	425	185	35.73	1.092	1299.15	.775
" 14.....	18.61	415	188.5	35.66	1.088	1291.77	.787
" 15.....	18.61	405	191.5	35.25	1.085	1286.49	.779
HEAD REDUCED.							
Whole Gate, 16.....	12.32	315	136	19.47	.962	1074.49	.778
" 17.....	12.32	320	131.5	19.10	.964	1078.83	.760
" 18.....	12.31	330	128.5	19.27	.968	1085.51	.763
" 19.....	12.31	310	137.5	19.37	.962	1074.49	.775
" 20.....	12.32	305	139	19.27	.960	1072.15	.772
Unreliable, 21.....	12.32	287.5	154.3	20.22	.956	1065.49	.816
HEAD REDUCED.							
Whole Gate, 22.....	8.91	200	128	11.63	.844	884.00	.781
" 23.....	8.85	225	114.5	12.01	.855	901.38	.797
" 24.....	8.85	250	103	11.71	.866	918.85	.762
HEAD REDUCED.							
Whole Gate, 25.....	6.79	135	119.5	7.33	.766	763.82	.748
" 26.....	6.77	140	117.5	7.75	.769	768.35	.769
" 27.....	6.77	150	111.5	7.60	.775	777.41	.764
Part Gate, 28.....	12.57	225	154.5	15.80	.856	902.97	.736
" 29.....	12.77	150	154.8	10.55	.739	723.45	.604
" 30.....	13.02	95	150	6.47	.587	528.59	.497
" 31.....	12.52	25	161	1.81	.445	350.59	.217

JAMES EMERSON.

HOLYOKE, MASS., September 30, 1872.

WHITNEY WHEEL.

This certifies that a Water Wheel, 30 inches in diameter, made of cast iron,—except buckets which were wrought iron—downward discharge, register gate, known as the Whitney Water Wheel, was sent to the Holyoke Testing Flume by Waldo Whitney, of Leominster, Mass., to be tested. The figures showing the results obtained by me, may be found on the opposite page. During the test the scale beam was attached to the brake at a point, which, if revolving, would describe a circle fifteen feet in circumference, consequently the revolutions of the wheel must be multiplied by fifteen to obtain the correct speed.

Data for one minute.

Length of Weir,	10 feet.
Temperature of Water,	32° Fah.
Weight of Water per cubic foot,	62.375 pounds.
Correction for Leakage, 18 feet head,	33 cubic feet.
Correction for Leakage, 12 feet head,	31 cubic feet.
Correction for Leakage, 6 feet head,	29 cubic feet.

REMARKS.

During the past three seasons I have tested ten wheels for Mr. Whitney, without obtaining results that would warrant their recommendation to manufacturers. In each case there has been some defect, generally a great falling off in power and useful effect from tabled rate in circulars issued by Mr. Whitney. The wheels have also been poorly constructed, the castings rough, and workmanship of inferior quality, so much so that, of the six or seven new wheels brought to my flume, all have required overhauling before they could be tried. Nearly all have bound in the case, but the greatest trouble has been their want of balance, which has caused them to shake the flume and buildings to an almost alarming extent, in fact, injury to the instruments has resulted from that cause. I have reason to believe that Mr. Whitney had no idea that wheels required balancing, and here let me remark, that one-half of the builders turn their wheels on an arbor, then key them to their shaft afterwards, which is sure to throw them out of balance, and to cause them to strike in the curb, if fitted as close as they should be. Another fatal defect in Mr. Whitney's wheels has been the difference between the size of the wheel and the inside of the curb, required to accommodate the gyrations of the wheel, owing to its being unbalanced.

The last time Mr. Whitney was experimenting, these defects were pointed out, one of his wheels taken to the machine shop and five pounds of iron added to the light side of the wheel, after which it was put in and run to its highest speed without the slightest irregularity, but, as it was 5-16 of an inch too small for its curb, it of course had no chance for high results. The defects were acknowledged, another wheel immediately constructed, sent here and tested. The results may be seen on the opposite page, and places the wheel among those worthy of patronage, and as Mr. Whitney announces himself as ready to sell his wheels on merit decided by actual trial of each wheel sold, there is no good reason why he should not be patronized.

JAMES EMERSON.

HOLYOKE, MASS, January 10, 1873.

WALDO WHITNEY, LEOMINSTER, MASS.

No. of Test.	Head.	Weight.	Rev. per Minute.	Horse Power.	Weir.	Cubic Feet.	Per Cent.
Whole Gate, 1...	18.48	400	195	35.45	.765	1283.41	.791
" 2...	18.48	410	192	35.78	.768	1291.09	.793
" 3...	18.47	420	188.5	35.99	.771	1298.77	.794
" 4...	18.46	430	186	36.35	.775	1309.03	.796
" 5...	18.46	440	184	36.80	.777	1311 61	.804
" 6...	18.50	450	181	37.00	.779	1316.77	.803
" 7...	18.50	460	178	37.21	.781	1321.93	.805
" 8...	18.50	470	175.5	37.49	.784	1332.23	.805
" 9...	18.51	480	173	37.74	.786	1337.39	.807
" 10...	18.50	490	171	38.09	.790	1347.76	.806
" 11...	18.49	500	168	38.18	.792	1352.96	.807
" 12...	18.49	510	166	38.48	.793	1355.76	.812
" 13...	18.48	520	163	38.52	.796	1371.19	.804
" 14...	18.47	530	162	39.00	.800	1373.78	.813
" 15...	18 48	540	159.5	39.15	.802	1379.00	.813
" 16...	18.46	550	155	38.75	.804	1383.22	.803
" 17...	18.45	560	149	37.92	.806	1388.44	.783
Head Reduced.							
Whole Gate, 19...	12.67	350	131	20.84	.706	1137.50	.765
" 20...	12.63	370	123	20.68	.710	1159.69	.747
" 21...	12.61	390	116	20.56	.718	1166.53	.740
" 22...	12.62	360	128	20.94	.709	1157.22	.759
" 23...	12.63	340	133	20.55	.702	1139.94	.755
" 24...	12 64	330	137	20.55	.699	1120.31	.763
" 25...	12.65	320	141	20.51	.695	1110.51	.772
Head Reduced.							
Whole Gate, 27 ..	6.81	150	111.5	7.60	.554	785.43	.752
" 28...	6.77	160	105	7.61	.558	792.53	.750
" 29...	6.75	170	99	7.65	.564	807.72	.742
" 30...	6.72	180	98.5	8.06	.567	814.66	.779
" 31...	6.70	190	88	7.60	.573	825.68	.727
" 32...	6.66	200	86.5	7.83	.580	841.31	.739
Part Gate,							
7/8 34...	18.51	450	163	33.34	.731	1197.48	.796
3/4 35...	18.74	390	162	28.72	.660	1024.16	.792
1/2 36...	19.20	200	157	14.27	.500	666.34	.590
1/4 37...	19.45	50	211	4.79	.378	460.83	.282
1/4 38...	19.45	50	142	3.22	.310	342.70	.255

HOUSTON WHEEL.

This certifies, that a Water Wheel 50 inches in diameter, made of cast iron, cast whole, Register gate, known as the Houston Water Wheel, was sent to the Holyoke Testing Flume by O. E. Merrill & Co., Beloit, Wisconsin, to be tested. The figures showing the exact results obtained by me, may be found on the opposite page. During the test the scale beam was attached to the break at a point, which, if revolving, would describe a circle twenty feet in circumference, consequently the revolutions of the wheel must be multiplied by twenty to obtain the correct speed.

Length of Weir,	10 feet.
Temperature of Water,	32° Fah.
Weight of Water per cubic foot,	62.375.
Correction for Leakage, 18 feet head,	93.40 feet.
Correction for Leakage, 12 feet head,	91.40 feet.
Correction for Leakage, 6 feet head,	89.40 feet.

REMARKS.

Previous to the trial of this wheel it had been frozen solid in ice at the bottom of the flume for two weeks; to clear it, crowbars, blocks of wood, axes and other implements were used, some of which entered the wheel with a crash when it first started, probably throwing it out of center, for it required the strength of two men applied to the rim of the brake (six feet in diameter) to turn the wheel when the gate was closed. The dynamometer (new) and shaft weighed five times as much as those previously used; the dash-pot or regulator to scale beam was too large; the man that operated the brake unused to the business; the surfaces of brake rough, consequently the results obtained are less equally graduated than usual. The leakage it will be observed was large; this was owing to the inner edge of the flange of the wheel projecting over the platform on which it stood. The trial was made to determine the effect of flaring extensions added to outer end of chutes, but owing to the many disadvantages under which the experiments were made, the trial can hardly be considered decisive, but would seem to add materially to the power of the wheel. Before the tests with the extensions off were made under six feet head, a claw hammer was accidentally dropped into the flume and passed through the wheel, which was running full speed under eight feet head, there was a tremendous crash, but as will be seen the wheel afterward gave greater power, probably owing to its having been loosened by the passage of the hammer. Since taking the wheel out I have looked but can discover no mark caused by the hammer, but I would not recommend running hammers through wheels generally.

The Company make two wheels for each diameter tabled. No. 1 is tabled, while No. 2 is ranked in power and discharge with the next size below, though its revolutions are supposed to accord with the tabled size. The wheel tested was a No. 2, and should be compared with 45-inch table in circular.

O. E. MERRILL & CO., BELOIT, WIS.

No. of Test.	Head.	Weight.	Rev. per Minute.	Horse Power.	Weir.	Cubic Feet.	Per Cent.
Whole Gate, 1...	18.00	1500	112	101.80	1.555	3660.33	.817
" 2...	17.96	1600	106	102.78	1.545	3625.01	.835
" 3...	18.22	1650	106.6	106.60	1.554	3656.85	.848
" 4...	18.07	1700	103.6	106.72	1.569	3710 12	.842
" 5...	18.08	1725	102	106 60	1.572	3720.80	.838
" 6...	18.06	1620	111	108.95	1.565	3695.88	.8635
" 7...	18.04	1630	109	107.68	1.566	3699.44	.8535
" 8...	18.04	1640	110	109.33	1.565	3695.88	.8675
" 9...	18.04	1660	108	108.65	1.570	3713.66	.858
Unreliable, 10...	18.04	1610	113	110.25	1.560	3678.12	.880
Part Gate, 12...	18.05	1400	113	95.88	1.520	3536.99	.797
" 13...	18.10	1240	117	87.92	1.484	3411.39	.721
" 14...	18 20	1040	119	75.01	1.400	3123.62	.556
" 15...	18.40	800	109	52.85	1.300	2823.82	.533
" 16...	18.58	575	110	38.33	1.126	2240.12	.539
" 17...	18.70	275	112	18.66	.960	1749.84	.302
Head Reduced.							
Whole Gate, 19...	11.94	1035	88	55.20	1.363	3001 29	.815
" 20...	11.96	1050	87.5	55.68	1 366	3012.23	.818
" 21...	11.98	1000	92	55.67	1.362	2997.95	.821
" 22...	11.97	1025	90	55.91	1.363	3001.29	.823
Head Reduced.							
Whole Gate, 24...	6.15	450	68	18.54	1.060	2044.86	.780
" 25...	6.15	475	65	18.70	1.062	2050.82	.782
" 26...	6.15	415	73.5	18.48	1.053	2024.07	.786
Second Day,	Flaring	Extensi	ons to	chutes	off.		
Whole Gate, 28...	17.95	1550	109	102.39	1.535	3689.72	.818
29...	17.95	1590	105	101.18	1.537	3596.78	.829
Doubtful, 30...	17.97	1535	113	105.12	1.525	3554.54	.8716
31...	17.97	1515	111	101.31	1.525	3554.54	.840
Part Gate, 33...	18.02	1300	116	91.39	1.490	3362.90	.798
" 34...	18.15	1140	115	79.45	1.400	3123.62	.741
" 35...	18.25	1000	110	66 67	1.315	2840.26	.680
" 36...	18.48	800	103	49.94	1.146	2301.59	.621
" 37...	18.62	500	105	31.81	1.030	1952.16	.463
" 38...	18.91	200	102	12.36	.850	1445.74	.240
Head Reduced.							
Whole Gate, 40...	12.30	980	94.5	56.40	1.336	2911.52	.832
" 41...	12.30	990	93	55.80	1.338	2918.14	.824
" 42...	12.30	940	97.5	55 54	1.328	2885.07	.828
" 43...	12 30	1000	92	55.75	1.340	2924.77	.820
Head Reduced.	Claw	hamm'r	went	through	the wh	eel.	
Whole Gate, 45...	6.45	440	73.5	19.60	1 063	2053.80	.786
" 46...	6.43	485	68.5	20.13	1.073	2083.67	.795
" 47...	6.43	495	67	20.10	1 074	2086.66	.793
" 48...	6.40	510	65	20.09	1.075	2089.65	.794
" 49...	6.43	475	69	19.83	1.072	2080.68	.784

Rodney Hunt Machine Co.,

ORANGE, MASS.

THIS certifies that a WATER WHEEL, thirty inches in diameter, made of cast iron, central and downward discharge, known as the Hunt Double Action Turbine was sent to the HOLYOKE TESTING FLUME by the Rodney Hunt Machine Co., of Orange, Mass., to be tested. The date of each test and the figures showing the exact results obtained by me, may be found on the following pages. During the test the scale beam was attached to the brake at a point, which, if revolving, would describe a circle fifteen feet in circumference, consequently the revolutions of the wheel must be multiplied by fifteen to obtain the correct speed. Data for one minute:

Length of Weir,	6 feet.
Temperature of Water,	40° Fah.
Weight of Water, per cubic foot,	62.373.
Correction for Leakage, 18 feet head,	14.20 cubic feet.
Correction for Leakage, 12 feet head,	12.20 cubic feet.
Correction for Leakage, 6 feet head,	10.20 cubic feet.

In the first edition of report for 1872, page 19, it is there stated that the Rodney Hunt Machine Co., of Orange, Mass., "have entered several wheels to be tested in the early Spring, the results of which will be made public at the time," in accordance with which, four wheels were sent to me even before my Flume was clear of ice, the object of sending so many was to determine the best form of wheel and guides. The first wheel tested was of ordinary finish; there were twenty-four buckets in the wheel, the guides being made of sheet iron about one-fourth of an inch in thickness. The results obtained may be found on opposite page, and they are the highest I have ever seen obtained from a 30-inch wheel.

The second wheel tested was a downward discharge, roughly made, the curb having thick cast iron guides with horizontal divisions—a common device with wheel builders—but the highest results at whole and part gate were obtained after the divisions were removed.

The third wheel had a hub half-way down, increasing in size with a curve from bottom upwards like the Tyler, Risdon, Burnham and other wheels, there were only nineteen buckets, half the length of center discharge being stopped by the hub; it was tested in the same curb as the second wheel, it gave about two-horse power more than the first wheel, and a useful effect of nearly eighty per cent., 79.47. The fourth wheel was like the first, except it had but nineteen instead of twenty-four buckets, tested in a curb with thick cast iron guides, under same head, gave about five-horse power more than the first wheel and a useful effect of 78½ per cent.

The center discharge of first wheel was then stopped and it was again tested, with less favorable results than at first, though about the same quantity of water was discharged. The company propose to continue their experiments.

JAMES EMERSON.

HUNT'S

Double Action Turbine Water Wheel.

No. of Test.	Head.	Weight.	Rev. per Minute.	Horse Power.	Weir.	Cubic Feet.	Per Centage.
Whole Gate, 1...	18.50	200	251	22.82	1.046	1223.55	.5346
" 2...	18.49	250	240	27.27	1.062	1251.36	.6249
" 3...	18.45	300	227.5	31.02	1.091	1302.23	.6846
" 4...	18.40	350	218.5	34.76	1.112	1348.43	.7429
" 5...	18.40	400	206	37.45	1.135	1380 53	.7835
" 6...	18.39	450	195	39.89	1.155	1416.57	.8119
" 7...	18.36	500	183	41 59	1.171	1445 59	.8309
" 8...	18.35	550	168	42.00	1.187	1474.79	.8229
" 9...	18.34	600	150	40.90	1.195	1489.44	.7776
" 10...	18.34	650	125.5	37.08	1.192	1473.94	.7245
" 11...	18.36	525	177.5	42.36	1.179	1460.17	.8388
" 12...	18.35	540	171	41.06	1.180	1461.99	.8187
" 13...	18.35	550	168.5	42.12	1.184	1469 30	.8275
" 14...	18.34	560	166	42.25	1.187	1474.80	.8260
" 15...	18.34	530	176.5	42.52	1.181	1463.82	.8385
" 16...	18.35	520	180.5	42.66	1.178	1458.34	.8433
" 17...	18.36	510	183	42.42	1.173	1449.23	.8425
" 18...	18.36	500	185	42.04	1.170	1443.77	.8409
Part Gate, 19...							
" 20...	18.37	475	190	41.02	1.158	1422.00	.8306
" 21...	18.38	490	186	41.42	1.160	1425.62	.8374
" 22...	18.36	500	183	41.59	1.163	1427.43	.8395
" 23...	18.42	440	182.7	36 54	1.123	1359.02	.7722
" 24...	18.40	450	185.5	37.94	1.125	1362.62	.8055
" 25...	18.40	460	176.6	36.92	1.128	1368.59	.7756
" 26...	18.61	250	179	20.34	.932	1030.04	.5613
" 27...	18.60	235	185	19.76	.927	1022.66	.5495
Head Reduced.							
" 30...	12.24	250	173.3	19.69	.983	1117.88	.7630
" 31...	12.20	275	165	20.62	.995	1138.16	.7856
" 32...	12.19	300	157.5	21.47	1.007	1158.55	.804
" 33...	12.17	320	151	21.96	1.018	1187.33	.804
" 34...	12.15	340	145	22.41	1.027	1192.77	.8199
" 35...	12.13	350	141.5	22.51	1 032	1201.37	.817
" 36...	12.13	360	137	22.41	1.036	1208.27	.8089
" 37...	12.13	370	134 5	22.62	1.037	1209.99	.8172
" 38...	12.13	380	129	22.28	1.037	1209.99	.803
" 39...	12 13	390	124	21.98	1.040	1215.17	.7888